V. NEW VERTEBRATES FROM THE MONTANA TERTIARY.

By Earl Douglass.

During the summer of 1902 explorations were continued by the writer in western Montana for the Carnegie Museum. Collections of rock samples, and of fossil plants, invertebrates, and vertebrates were obtained from the Oligocene and Miocene formations. Special effort was made to discover the conditions under which the various deposits were formed. While it will require much work and careful study to interpret the history of Tertiary times in this region, it is nevertheless important to record such data as tend to elucidate the problem. In this preliminary sketch the writer wishes to give only a few of the leading facts, leaving a more thorough discussion of the matter to a time when more extended explorations have been completed and a careful study of the material already collected has been made.

The fossil mammals found during the past summer have not yet been studied. Those described in the present paper were collected by the writer in previous years extending back as far as 1895.

EOCENE?

Sage Creek Beds.

This formation occurs on Sage Creek about seven miles northeast of Lima in Beaverhead County. Only four specimens were found that are of any value in determining the age of the formation. One of these (*Heptodon?*) is undoubtedly Eocene. Two specimens that I have referred to *Hyrachyus* were found, but one consists of a solitary tooth; and the other—a mandible, atlas, and part of a skull—looks like a more modern form than we would expect to find associated with *Heptodon*. The last specimen — a part of a mandible — has all the peculiar characters of the corresponding portion of *Metamynodon?* but is very much smaller than the White River species. However, the *Hyrachyus* skull was found a few feet under the specimen of *Heptodon*, and the *Metamynodon* jaw a few feet under the stratum that contained the solitary tooth which resembles *Hyrachyus*.

Fossils were found in only a restricted locality. The hill where *Heptodon ?* and the jaws of *Hyrachyus ?* were found is composed of stratified material, and it contains quartz geodes, tubes lined with crystals both of calcite and quartz, and calcified trunks and twigs of trees.

It is hoped that these beds will soon be more fully and carefully explored.

LIST OF SPECIES.

Heptodon ?
Hyrachyus priscus Douglass.
Hyrachyus ?
Metamynodon ?

OLIGOCENE.

THE WHITE RIVER FORMATION.

That a great part of the White River deposits of Montana was formed in water is evident. It does not appear that the water was, as a rule, very deep. There are undoubtedly not only lake, but marsh and river deposits. The evidence points to some slow acting obstruction of the water, rather than to a more sudden appearance of high barriers making deep lakes which were in course of time gradually drained by the cutting of a channel through the barriers. The conditions could be better explained by supposing that there was slow and inconstant upheavals or oscillations across the path of drainage. When the rate of elevation of the barrier was greater than the rate of deepening of the channel through it, there would be ponding of the water. The excess of erosion would, if it operated long enough, lower the water level, thus making dry and marshland where water had been before. So in the long time in which there was an unequal rate of raising of the barrier the conditions would be very complex. The relation between the rate of elevation of the barrier, sedimentation, and erosion of the channel were such that the water of the lakes was not usually of great depth. There are undoubtedly not only lake, but nearly all kinds of fresh water deposits as we should expect under such conditions.

This is only a hypothesis which remains to be proven or disproven, but which at the present time seems to the writer to best accord with the data at hand.

We find nearly everywhere evidences of shallow water, such as ripple marks, bird tracks, plant remains, shallow water mollusca, etc.

There is much volcanic dust in the beds, some strata being made up almost entirely of this material. Of course these beds of pure dust must have been transported from their source by the winds.

The arguments used by Matthew to prove that the White River of the plains is not of lacustrine origin do not apply here.

1. The deposits, especially the finer ones, are commonly distinctly stratified, often thinly laminated, and sometimes splitting into papery shales. Distinctly stratified beds can often be traced for a considerable distance and sometimes they are beautifully ripple-marked.

2. The fauna is not strictly a terrestrial one. Abundance of fresh water diatoms, mollusca, and fish are found.

3. The mammalian remains are usually fragmentary, and occur near hills and mountains of older rocks, which evidently formed the shore of the lakes, or border of the marshes, if such existed.

4. There is no difficulty in conceiving the obstruction of the waters by orographic movements or by lava flows. For example, the Missouri River from the region of Helena northward to Cascade — a distance of about fifty miles — flows through a cañon in the mountain uplift, which here crosses its course. For the first twenty-five miles there are successions of narrow cañons and broader semi-circular areas. In the latter are remains of Tertiary deposits, showing that these valleys were carved out during or previous to Tertiary times. But from near the place where Wolf Creek enters the Missouri there is a change, and the river, instead of cutting its way through Palæozoic strata, has carved a uniformly narrow cañon through eruptive rock. Above this long cañon we can trace the Tertiary deposits, occupying present and old river valleys up the Missouri and Jefferson rivers without obstruction of the older rocks to the continental divide and boundary line between Montana and Idaho, near the village of Monida. In fact the old river valley undoubtedly passes through the divide into Idaho.

The occurrence of this great mass of eruptive rock, were it a surface flow, would seem to offer a ready explanation of the occurrence of the fresh water sediments above. But much of the rock is quite coarsely crystalline, as if cooled at a considerable depth.

It is true that in no place on the mountain sides has the writer

[1] The coarser material is evidently either of delta or stream origin. The writer at present sees no reason for believing that any great extent of the deposits is purely æolian.

found what one could be sure were old lake terraces. But this does not appear to be any evidence of the absence of lakes, for in a region of comparatively rapid erosion, we could hardly expect them to endure so long.

Fossil plants were collected in several places in the White River during the last summer. In one locality in the Lower Madison Valley *tracks of birds* were found on the sandstone. Just above were beds of pure volcanic ash beautifully ripple-marked.

The lower division of the White River — the Titanotherium Beds — east of Winston and southeast of Helena, attain a considerable thickness. One measurement gave 4500 feet, another farther south 4900 feet. Where this latter measurement was made a fault occurs, the exact displacement of which was not ascertained and it is possible that this might bring this measurement a little nearer to the former one. The beds vary from nearly horizontal to a dip of 53°. These measurements do not include the whole thickness of the White River here. The Missouri Valley makes a gap of a couple of miles and when seen again across the river the strata are nearly horizontal and have changed in character. About 150 feet of strata are exposed here. Adding this to the 4900 feet we have here a measurable thickness of 5050. How much is lost by the erosion of the river valley it is not possible to tell. The upper beds here are like the lower ones exposed on the Madison River. Above the latter, on the Madison, I measured 300 feet of mostly fine, stratified deposit.

There is a possibility that the lowermost of these beds may extend down into the Eocene, though there is at present no evidence of this.

At some time, either previous to or succeeding the White River epoch, the rivers of western Montana underwent much change, for in many places they leave the older valleys which were filled, or partly filled, with Tertiary deposits and flow through deep narrow cañons in the Archæan and Palæozoic rocks. About ten miles below Whitehall the Jefferson flows eastward through a long cañon, while both north and south are old valleys containing only Tertiary or later deposits. In many places the streams have left what seems to be their easy, natural course and made their difficult way through old granite, limestone, and quartzite rocks.

The beds in the vicinity of Helena contain much sand and coarser material, waterworn gravel brought from a distance, and unworn angular fragments from the adjacent Algonkian slates and quartzites.

In the lower Madison Valley, where the upper beds are so well exposed, the material is mostly fine.[1]

Northeastward from Whitehall the rock of the Titanotherium beds has been much disturbed and metamorphosed, the light colored clay and sand being in great part changed into red and black slate and quartzite. In one place the strata are nearly vertical. In some places there are mineral veins and the rock has a granitic structure.

There is doubt that the mountains were as high during the White River epoch as at the present time.

Besides the places where fossils had been previously found, they were discovered last summer at Cañon Ferry, in the Prickly Pear valley, northeast of Whitehall, and on the divide between the Missouri and North Boulder valleys.

The beds in Montana appear in the main to represent the Titanotherium and Oreodon Beds of South Dakota.

List of Fossils.

Fossil Plants.
Fish.
Helodermoides tuberculatus Douglass.
Ictops acutidens Douglass.
Gymnoptychus minor (Douglass).
Cylindrodon fontis Douglass.
Sciurus jeffersoni Douglass.
Ischyromys typus Leidy.
Palæolagus temnodon Douglass.
Palæolagus brachyodon Matthew.
Hyænodon minutus Douglass.
Hyænodon montanus Douglass.[2]
Limnenetes platyceps Douglass.
Limnenetes ? anceps Douglass.
Trigenicus socialis Douglass.
Oreodon macrorhinus Douglass.
Eucrotapus helenæ Douglass.
Agriochœrus minimus Douglass.

[1] The exact horizon of these upper beds is uncertain, as no good mammals have been found, but they lie unconformably under the Loup Fork. I have always considered them as White River.

[2] Matthew thinks this is probably *Pseudopterodon*. *Bull. Am. Mus. Nat. Hist.*, May 19, 1903.

Agriochœrus maximus Douglass.
Colodon cingulatus Douglass.
Mesohippus bairdi Leidy.
Mesohippus latidens Douglass.
Hyracodon.
Titanotherium.

THE FORT LOGAN BEDS.

The so-called Deep River Beds and their interesting mammalian fauna are well known through the labors of Cope and Scott. There is, however, much unavoidable confusion continually arising from the use of one name for two distinct horizons. The name "Deep River" is used without the adjectives "upper" or "lower" and one does not always know what is meant. Whether or not, as Scott thinks probable, one is John Day (Upper Oligocene) and the other Loup Fork, it is certain that they have different assemblages of fossils, and that each should have a name by which it may be clearly distinguished. The river in whose valley the Deep River beds occur is now universally known as Smith River, and this is probably the true name; though as early as 1876 Grinnell and Dana called this stream "Deep Creek."

However this may be, I do not think that this should invalidate the name so long as the type locality is beyond doubt. The beds are in the valley of what is now known as Smith River, between the town of White Sulphur Springs and old Fort Logan and between the Little Belt Mountains on the east and the Big Belt Mountains on the west.[1]

Scott[2] first gave the name "Deep River beds" as a substitute for Cope's "Ticholeptus beds." Scott says in his "Mammalia of the Deep River Beds" (p. 59): "The upper beds which Grinnell and Dana called Pliocene present a very different assemblage of species. Cope's collection, so far as I can judge, was gathered entirely from these beds and contains nothing from the lower horizon." It seems to the writer, then, that the name Deep River should be applied to the upper beds alone.

For the older formation, Upper Oligocene (John Day?), I propose the name Fort Logan beds, from the old military post a short distance from the best outcrops. I do not know that this horizon is exactly paralleled by any other.

[1] Rep. of Reconnaissance from Carroll, Montana, to the Yellowstone National Park, made by Capt. Ludlow in 1875; Washington, 1876, p. 115.

[2] Princeton Scientific Expedition of 1891. Prin. Col. Bull., III., p. 88.

The following list of fossils from this horizon is taken from Scott's Mammalia of the Deep River Beds, p. 58.

Cynodesmus thoöides Scott.
Steneofiber montanus Scott.
Cænopus.
Miohippus annectens ? Marsh.
M. anceps ? Marsh.
M. (*Anchiterium*) *equiceps ?* Cope.
Mesoreodon chelonyx Scott.
M. intermedius Scott.
Pœbrotherium sp.
Hypertragulus calcaratus Cope.

Beds Doubtfully Oligocene.

Besides the beds which I have called Fort Logan and which Scott suspects are John Day, the writer has, in previous years, found localities where the few fossils that were found and also the lithological character of the beds seem to indicate a formation intermediate between the White River and Loup Fork. One locality in which the best material was found is about three miles east of the town of Drummond on the Hellgate River. Only three good specimens were obtained here and none of these can I identify with species found elsewhere.

The strata are light colored, resembling the White River in some respects, yet more like part of the Loup Fork in not being distinctly stratified.

List of Fossils.

Mesocyon ? drummondensis Douglass.
Leptomeryx transmontanus Douglass.
Promerycochœrus minor Douglass.

MIOCENE.

The Loup Fork Formation.

In the valleys of western Montana there are at least three phases of the Loup Fork — that is, there are beds with three different assemblages of fossils. How much of this is due to actual difference of time and how much to different conditions of preservation is difficult to determine. The valuable suggestions, which Dr. W. D. Matthew[1]

[1] "Fossil Mammals from Colorado," and "Is the White River an Aeolian Dedosit?"

has made concerning the habitat of extinct mammals are worthy of the most careful thought and study.

In this same region to-day there are animals that live high among the rocks of the mountain peaks. These we would expect to be extremely rare in lacustrine or fluviatile deposits. Others, like some species of deer, live principally in the wooded mountains and drink from mountain streams. These under present conditions would seldom be preserved, yet, when lakes and marshes were more extensive, and when the valleys were not cultivated, the chances would be greater.

It is interesting to notice the difference in habits of domestic horses and cattle, when left to themselves. Domestication has not entirely changed their natures. In this mountainous region horses will come down to the streams from the dry hills to drink once in one, two, or three days according to the weather. They come in bands, usually in the afternoons of hot summer days, drink their fill, and go far back to the hills, perhaps miles from their watering places. Cattle remain nearer to water as they are not so "well built for speed," come down to streams and ponds to drink, and linger in or near the water during the heat of the day. They often die near these watering places. In swamps they get mired, and not having the strength to extricate themselves, leave their bones in a favorable place for preservation. It is easy to see which of these animals, cattle or horses, under present conditions would stand the better chance of being preserved in aqueous deposits; though any animal going to a watering place during its last sickness is very apt to leave its bones near by.

Last summer the party in charge of the writer found a place in the Deep River beds, where skulls and portions of skeletons were abundant; but with the exception of turtles and some mammalian fragments, they all belonged to the *Oreodontidæ*. In one locality on the North Boulder only turtles, camels, and horses were found. The latter probably represents a little later phase of the Loup Fork, yet no one would claim that in either case the fossils were a just representation of the fauna of the times. It is possible that these Oreodonts found in marshes, where other mammals seldom came, their most natural feeding ground.

THE DEEP RIVER BEDS.

For a description of these beds in their typical locality near White Sulphur Springs I would refer to Scott's valuable paper, *The Mam-*

malia of the Deep River Beds. During the last summer this formation was identified at Cañon Ferry on the Missouri River about twenty miles east of Helena. Here many skulls of *Promerycochœrus*, *Cyclopidius*, *Merychyus* and other *Oreodonts* were obtained.

What are evidently the same beds were found on the North Boulder opposite Cold Spring Postoffice. The fragments of fossils seen appeared to be the same as those obtained at Cañon Ferry; but they were found during a reconnaissance on horseback and not collected by the writer. The character of the beds is nearly identical.

The Flint Creek Beds.

These have not been visited by the writer since 1899.[1] Several fossil mammals were found; but, with one or two exceptions, they cannot be identified with species found in other places. These exceptions are portions of four skulls of (*a*) *Palæomeryx*, one of which is nearly complete with one side of the mandible. There may be two species, but one is undoubtedly *Palæomeryx borealis* (Cope). (*b*) *Mylagaulus paniensis* is identified by the premolar tooth only, which does not differ from that of the type. The following is a list of the species:

Ogmophis arenarum Douglass.
Talpa ? platybrachys Douglass.
Sciurus.
Mylagaulus paniensis Matthew.
Ælurodon ? brachygnathus Douglass.
Protohippus ?
Hesperhys vagrans Douglass.
Merychyus smithi Douglass.
Poatrephes paludicola Douglass.
Merycochœrus laticeps Douglass.
Procamelus.
Palæomeryx borealis[2] (Cope).

These were all found near the village of New Chicago in Granite County.

The typical exposure forms a line of bluffs 100 to 150 or more feet

[1] See *Am. Journ. Sc.*, Vol. 10, Dec., 1900, p. 428.

[2] There is some doubt that this is *Palæomeryx*, but I see no conclusive evidence that it is not; so, until the matter can be settled, it is best to include the American specimens with the European genus.

in height on the west side of the valley of Flint Creek, beginning about one mile north of the village of New Chicago and extending southward several miles. The fossils were obtained within two or three miles of the village.

THE MADISON VALLEY BEDS.

The Loup Fork beds of the Lower Madison Valley are, in *great part*, at least, of stream valley origin. By this I mean such deposits as usually accumulate in valleys of rivers and smaller streams, including channel deposits, mud flats, sand bars, flood plains, ponds, and small lakes.

The material is principally sand, sandy clay, and gravel, partly without extensive uniformity of stratification. Yet in part the beds are well stratified. This is especially true of those of pure volcanic ash, and it seems almost certain that at times during the Loup Fork there were quite extensive marshes, or lakes.

During last season these beds were identified in the Missouri Valley east of Winston by mammalian fossils. The remains of camels (*Procamelus*) and horses (*Protohippus*) were found on the north Boulder Creek in beds that undoubtedly belong to this division of the Loup Fork.

An abundance of fossil leaves was found both in the Lower Madison Valley and east of Winston.

PARTIAL LIST OF SPECIES.

Sciurus arctomyoides Douglass.
Palæarctomys montanus Douglass.
Palæarctomys macrorhinus Douglass.
Mylagaulus ? pristinus Douglass.
Mylagaulus ? proximus Douglass.
Mustela minor Douglass.
Ælurodon sp.
Dinocyon ossifragus Douglass.
Aphelops ceratorhinus Douglass.
Protohippus.
Hippotherium isonesum Cope.
Merycochærus altiramus Douglass.
Merycochærus madisonius Douglass.
Gomphotherium (*Protomeryx ?*) *serus* Douglass.
Protolabis montanus Douglass.
Procamelus madisonius Douglass.
Procamelus lacustris Douglass.
Blastomeryx gemmifer Cope.

Merycodus necatus Leidy.
Merycodus ? agilis (Douglass).
Palæomeryx americanus Douglass.
Palæomeryx borealis (Cope).
Mastodon.

These beds overlie the White River and occupy the top of the triangular bench between the Madison and Gallatin rivers from the vicinity of Logan on the north, nearly to Elk Creek on the south; also the tops of the high bench west of the Madison River.

DESCRIPTIONS OF NEW GENERA AND SPECIES.

All the fossils described in this paper were collected by the writer, unless otherwise stated. The drawings were made by Mr. S. Prentice. The numbers given to the specimens are the Carnegie Museum numbers.

EOCENE? (SAGE CREEK BEDS.)

PERISSODACTYLA.

HEPTODON?

No. 717. Fig. 1.

Part of a superior maxillary with the last premolar and the three molars on the left side. From the Sage Creek beds northeast of Lima.

It is doubtful whether this should be assigned to the genus *Heptodon* or to *Systemodon*. Taking Dr. Wortman's distinguishing characters of the teeth it is intermediate between the two. A comparison with the specimens in the American Museum of Natural History confirms this, but it seems to be nearer to *Heptodon* than to *Systemodon*, appearing to be some more primitive form of that genus.

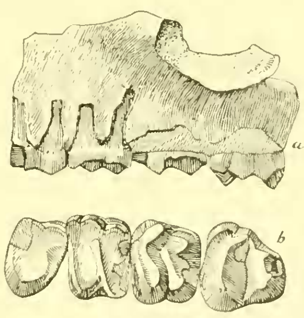

FIG. 1. *Heptodon?* (717), Sage Creek Beds. Natural size. *a.* Part of left maxillary with last premolar and three molars. *b.* Crown view of teeth of same.

The cross crests are low. The posterior outer cusp in M^3 is flat and pushed far inward, making the metaloph very short, and the tooth nearly an equilateral triangle in outline as seen from above. In M^2 the posterior outer cone is a trifle convex outwardly, though it is slightly concave near the posterior edge. In

M^1 this element of the tooth is decidedly convex and nearly on an antero-posterior line with the anterior outer cone. P^4 had but one cross-crest. The tooth stands obliquely, the inner portion being farther forward.

MEASUREMENTS.

	Mm.
Height of the lower border of orbit above alveolar border at M^2..	18
Length of P^4	7.5
Width " "	10.5
Length of M^1	8.5
Width " "	10.5
Length of M^2	10
Length of M^3	11
Width	12
Height of crown of M^3	3.3

From Sage Creek about seven miles northeast of Lima.

HYRACHYUS ? PRISCUS sp. nov.

No. 784. Fig. 2.

The type includes the greater part of the mandible with all the post-canines except P_1, the anterior part of the skull with incisors and premolars, and the atlas. It was found a few feet below the specimen of *Heptodon ?* just described.

The premaxillaries are rather slender and entirely separated. The diastema between the canine and the first premolar moderately long; P^1 small; premolars increasing rapidly in size posteriorly; P^2 beginning to assume the molar pattern — that is, the inner lobe is beginning to divide, though no such tendency appears in P^3 and P^4; mandible heavy and thick; symphyseal part proportionately slender; masseteric fossa high; angle broad; lower border convex antero-posteriorly.

The premaxillaries resemble those of the modern tapir (*Elasmognathus*) in form, but they are not coössified anteriorly and are not nearly so robust. Near the anterior inner part of the right premaxillary there was a small, peg-like process projecting backward and toward the other premaxillary, but no sign of a union of the two premaxillaries. The diastema between the canine and P^1 was proportionally as long as in *Elasmognathus*. The infraorbital foramen opens above P^3.

The specimen was in a breccia formed by the breaking up and recementing of the sandstone so parts of the broken skull were separated. Fragments of the upper part of the skull, including portions of the nasals, were put together and it appears that the nasals were reduced and shortened, in this respect being intermediate between *Hyrachyus* and *Protapirus.* The anterior upper portion of the skull is broadly and evenly convex.

The longitudinal portion of the mandible is robust, but it contracts just in front of the anterior premolar, making the symphyseal region small. The ascending portion is broad. The angle extends a little below the posterior lower border of the horizontal ramus. The last mo-

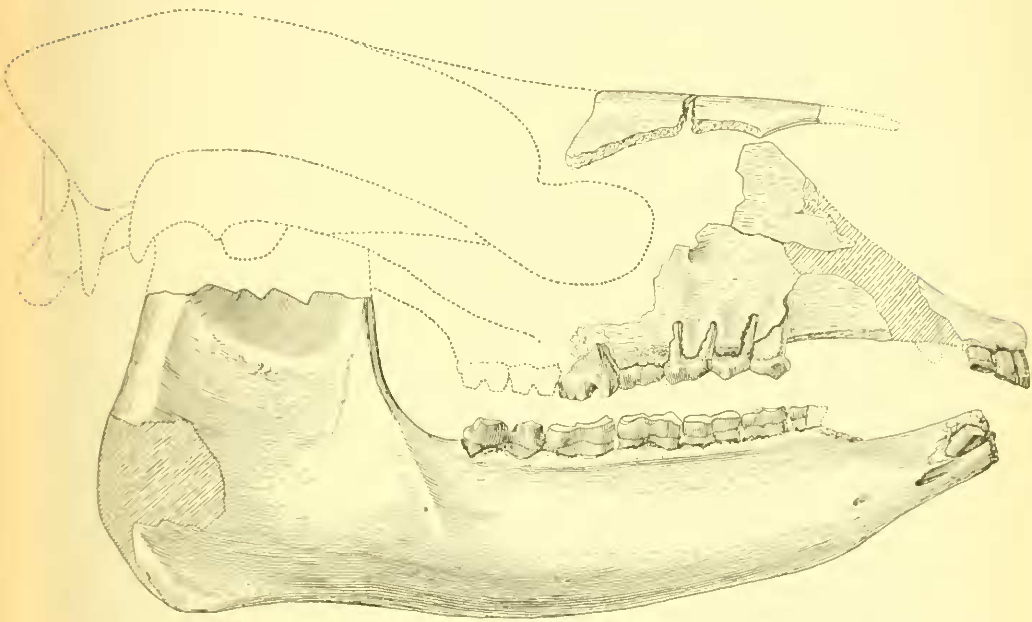

FIG. 2. *Hyrachyus priscus.* No. 784. Sage Creek Beds. One half natural size.

lar is considerably in advance of the ascending ramus The masseteric fossa extends nearly down to the level of the molars.

The animal was old and not all of the structure of the teeth can be made out on account of their worn condition. The worn surfaces of the upper incisors are oblong-oval or elliptical. They stand in a nearly vertical position as in the tapir. They are all nearly of the same size. The premolars are very much like those of *H. agrarius.* P^1 is small. P^2 is the only one which appears to have a tendency to assume the molar pattern. There are internal cingula on the last two premolars. The lower teeth are much like those of *H. agrarius*.

The atlas is much like that of *Protapirus validus*. The concavity for the odontoid process of the axis is much narrower, indicating a thick, conical odontoid. The posterior cotyles are wider dorso-ventrally, the lower part is longer antero-posteriorly on the median line, and there is quite a large protuberance on the ventral posterior border, projecting backward.

MEASUREMENTS.

	Mm.
Width of palate between second premolars	38
Length of I^2	8
Width of I^2	5
Length of premolar series	46.5
Length of P^1	10
Width of P^1	7
Length of P^2	9.7
Width of P^2	12
Length of P^3	13
Width of P^3	18.6
Length of P^4	19.5
Width of P^4	22
Length of mandible about	250
Width " at symphysis, narrowest	26
Depth " under P^1	38
Depth " under M^3	47
Length of inferior molar-premolar series	98

From same locality as the preceding.

HYRACHYUS.

No. 718. Fig. 3.

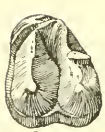

FIG. 3. *Hyrachyus?* No. 718. Crown view of last left upper molar. Sage Creek beds. ½ nat. size.

Represented by a solitary last upper molar found about a half mile from *Heptodon* (No. 717) and *Hyrachyus priscus* (No. 784) described in this paper. It resembles the corresponding tooth of *Hyrachyus intermedius* (Princeton collection, No. 10,095). The anterior cross-crest is more nearly straight, and being broader at the base, makes the median transverse valley more narrow. The anterior inner cusp is more conical. The anterior outer style (parastyle) is not so much external to the anterior outer cusp. The posterior outer cusp (metacone) is small, thin, laterally compressed and low. It is much lower than the other three principal cusps. There is a strong anterior cingulum and a weaker one on the outside of the outer exterior style.

MEASUREMENTS.

	Mm.
Length of M^3	13
Width of M^3	16
Height of antero-internal cusp	9

From Sage Creek about seven miles northeast of Lima.

METAMYNODON?

No. 734.

A horizontal ramus of a mandible with the alveoli and roots of the teeth.

This jaw is somewhat puzzling. It was found in the beds on Sage creek in a sandy lens or layer lower down than the stratum from which the *Hyrachyus?* tooth (No. 718) was obtained and not far away. This specimen if found in the White River would be unhesitatingly referred to the genus *Metamynodon*, though it is very much smaller than *M. planifrons*. But there is the same reduction in number of the incisors and premolars, the enormous enlargement of the canines, the great lengthening of the symphysis and narrowing of the premolars. In minor details, too, it is the same, about the only differences being the smaller size, the more procumbent position of the canines, and the thinner horizontal ramus.

The last incisors were quite large and in contact with the canines. There were probably second incisors, but they were very small. Part of the alveolus of one can be seen. The three premolars were all small. The root of the canines was very large and the two nearly came in contact. They occupied the greater part of the symphysis. There is a longitudinal convexity on the outer side of the one preserved. The symphysis extends backward to P_4 and the posterior part is wide.

One would not expect to find an animal apparently so like *Metamynodon* in the Middle Eocene, but the data are given for what they are worth.

MEASUREMENTS.

	Mm.
From anterior of canine to posterior of $M_{\bar{3}}$	208
Length of symphysis	110
Width of posterior border of symphysis, between horizontal rami	24
Width of jaw at canines	60
Depth " under $P_{\bar{2}}$	50
Depth " " $M_{\bar{1}}$	54
Thickness " " $M_{\bar{3}}$	32
Length of canine	28
Width of canine	25
Length of diastema between C and $P_{\bar{2}}$	36
Length of premolar series	46
Length of molar series	100

From Sage Creek about seven miles northeast of Lima.

OLIGOCENE.

WHITE RIVER.

REPTILIA.

HELODERMOIDES TUBERCULATUS gen. et sp. nov.

No. 707. Figs. 4 and 5.

Portions of the top of a skull and part of a mandible were found in the beds on Pipestone Creek near Pipestone Springs in Jefferson County.

The bone in the frontal region is thick and cellular, but is much thicker farther forward. The top of the skull, as in *Heloderma*, is

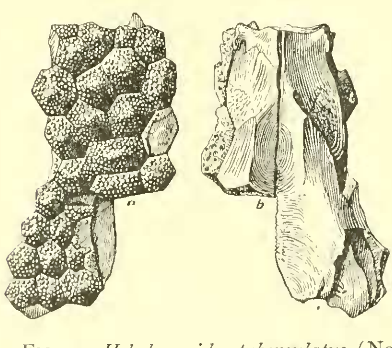

FIG. 4. *Helodermoides tuberculatus* (No. 707), White River Beds, Pipestone Creek. *a*, top of skull, upper view; *b*, the same, lower view. Natural size.

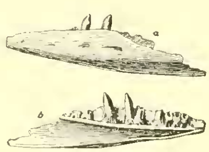

FIG. 5. Same as Fig. 4. Part of mandible. *a*, outer view; *b*, inner view. Natural size.

covered with bony ossicles. They are higher and more conical than in that genus, and instead of being marked with minute pits are covered with little rounded wart-like protuberances. The larger ossicles approach a pentagonal or hexagonal form at the base. Two, near the middle of the head, are elongated transversely. Anterior to these there is no bilateral symmetry in their arrangement or size. The posterior ones, as in *Heloderma*, are smaller than the anterior ones.

The mandible shows three foramina on the outer surface. The teeth, which are partly set in the jaw, are sharp, laterally compressed near the apex, and incline slightly backward.

Length of fragment of skull, 40 mm.

MAMMALIA.

PERISSODACTYLA.

MESOHIPPUS LATIDENS sp. nov.

No. 751. Fig. 7.

The type of this species is a portion of a crushed and flattened skull with the last premolar and the molars of both sides. It was found in the Lower White River beds near Three Forks in 1899.

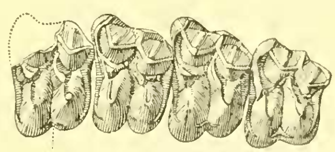

FIG. 7. *Mesohippus latidens* (No. 751). Last upper premolar and the three molars of left side. Natural size. White River beds near Three Forks.

The most striking distinguishing character of the teeth is the extreme transverse as compared with the antero-posterior diameter and the much greater width of the anterior than of the posterior portions. The teeth are more primitive than those of *M. bairdi*. The median tubercles of the anterior cross-crests are much larger than those of the posterior cross-crests. The posterior intermediate cingular cusps are represented by only a minute enlargement or thickening of the cingulum. There are no cingula on the inner faces of the inner cusps except on M^3. There are faint median ridges on the outer crescents. The posterior intermediate cusps on the cross-crests decrease in size from M^1 backward. On M^3 this cusp can hardly be distinguished from the cross-crests.

MEASUREMENTS.

	Mm.
Length of P^4 and the 3 molars	42
Length of molar series	32
Length of P^4	10
Length of M^1	10
Width of M^1	16
Length of M^2	11
Width of M^2	17
Length of M^3	11
Width of M^3	15.5

Found on Thompson's creek.

ARTIODACTYLA.

TRIGENICUS SOCIALIS gen. et sp. nov.

No. 817. Fig. 6.

In the autumn of 1901 the writer reëxamined a portion of the lower White River beds on Thompson's Creek near Three Forks. In a place where fragments of several skulls (including the types of

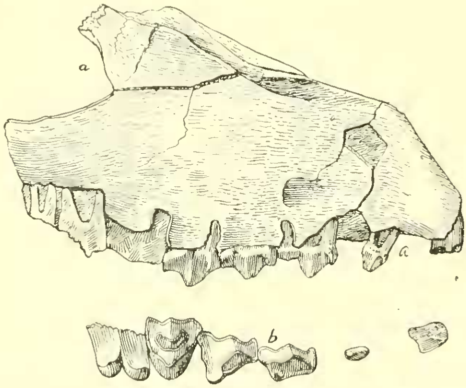

FIG. 6. *Trigenicus socialis* (No. 817), White River beds, near Three Forks. Natural Size. *a*, portion of skull; *b*, crown view of teeth.

Limnenetes platyceps and *L. ? anceps*) had been found, the anterior portion of another skull was obtained. It is laterally crushed at muzzle. It does not exactly correspond with anything that has been described, though it bears resemblance to several of the Uinta and

White River selenodonts. It looks as though it might be a descendant of *Leptoreodon.*

The dental formula is C^1, P^4, M^3. All are large and strong, except P^1, which is small, but two-rooted. It is separated from the canine and P^2 by diastemata. It is a little nearer to P^2 than to the canine. The canine is, so far as preserved, of the usual *Oreodont* pattern, but is more compressed laterally. P^1 is a laterally compressed subconical cusp. The crown from the outside has a slight hint of the trifid appearance of the same view of P^2 and P^3 — that is, there are rudiments of anterior and posterior cusps or lobes. P^2 is large and has three outer lobes. It is widest back of the middle. P^3 is a little longer and more triangular on account of the larger posterior inner lobe. P^4 is of the usual pattern in ruminants. Premolars 2 and 4 are nearly equal in length. Only portions of the molars are preserved, but the teeth are large. The teeth back of P^1 show much wear.

The infraorbital foramen opens above the anterior portion of P^3, and the front margin of the orbit is above the anterior half of M^2. So far as I can ascertain from the crushed condition in this region there were neither prelachrymal pits or vacuities.

MEASUREMENTS.

	Mm.
From front of canine to front of orbit	50
Length of canine	4.3
Width of canine	3.3
Length of diastema between C and P^1	6
Length of P^1	3.5
Width of P^1	2
Length of diastema between P^1 and P^2	4
Length of P^2	7
Width " "	4
Length of P^3	9
Width " "	5
Length of P^4	7
Width " "	7
Length of M^1	7.5
Length of M^2	9

OREODON MACRORHINUS sp. nov.

No. 767. Fig. 8.

In my paper "Fossil Mammalia of the White River Beds of Montana" [1] I described a species of Oreodon under the name of "*Oreodon*

[1] *Trans. Am. Phil. Soc.*, Vol. XX., p. 264.

robustum." I knew that the name had been given by Leidy to an individual belonging to *O. culbertsoni*, but considered the name still available. I propose for it the specific name *macrorhinus*.

The skull is not much if any longer than that of *O. culbertsoni* Leidy, but is very much heavier, and I think the differences are not

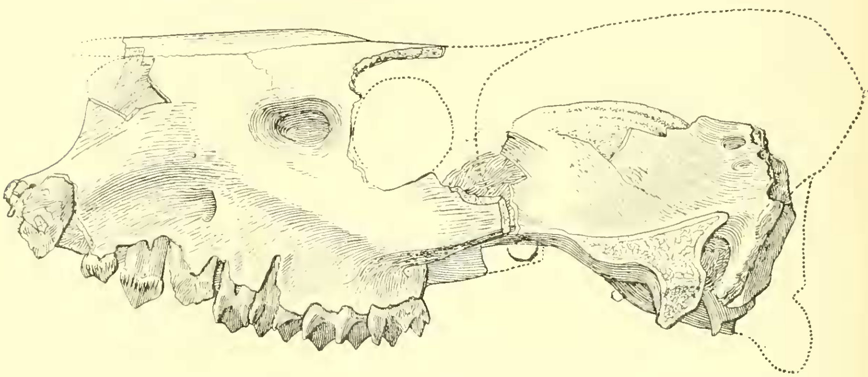

FIG. 8. *Oreodon macrorhinus* (No. 767), White River beds, near Toston, Mont. One half natural size.

sexual. As seen from the side the muzzle tapers very little. The enamel on the premolar teeth is wrinkled.

The nodular beds from which this was taken undoubtedly correspond with the "Oreodon beds" of the plains region.

UPPER OLIGOCENE?

CARNIVORA.

MESOCYON? DRUMMONDANUS sp. nov.

No. 792. Figs. 9 and 10.

Of this dog there is the scapula, some fragments of other parts of the skeleton, and a skull lacking the mandible. It was found about three or four miles east of Drummond, near the Hellgate River.

As the lower teeth are not present it cannot be certainly referred to its proper genus. The species, however, is different from any I have seen. I cannot better define it than by showing how it differs from *Mesocyon coryphæus* Cope, and *Cynodesmus thoöides* Scott.

Compared with *M. coryphæus* it is somewhat smaller, not so much restricted behind the orbit; the sagittal crest is not so elevated; the nasals do not contract so gradually to the apex; and judging by Cope's figure,[1] they are longer; the posterior points of the premaxillaries do not approach so near to the anterior projections of the frontals, the former being short fore and aft. The tympanic bullæ are smaller. The antemolars are less spaced; the incisors are crowded. According to Cope's figure P^2, P^3, and P^4, exclusive of the heel, are wider but of the same length. The heel on P^3 and the deuterocone on the sectorial are not so well developed; M^2 is much larger, the great difference being in the antero-posterior diameter.

Comparison with *Cynodesmus thoöides.*

The anterior part of the skull is lower and narrower; not so broad at the post-orbital angles of the frontals but broader at the post-orbital constriction; the temporal ridges converge less rapidly; the premaxillaries and frontals do not approach so near each other; the premolar teeth are smaller, much lower, and all except thefirst are shorter. The deuterocone on P^4 is less prominent; the transverse diameter of the molars is less.

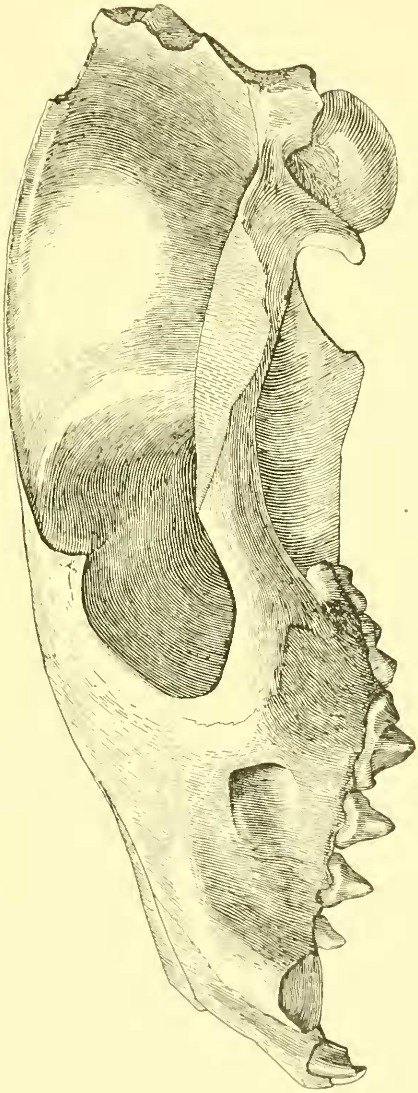

FIG. 9. *Mesocyon ? drummondanus* (No. 792). Upper Oligocene? beds, near Drummond, Mont. Natural size. Side view of skull.

[1] Tertiary Vertebrata, Pl. LXXI.

The basisphenoid is keeled. The brain-case is full and well rounded out. The zygomatic arch is not widely expanded. The frontals can hardly be said to have postorbital processes.

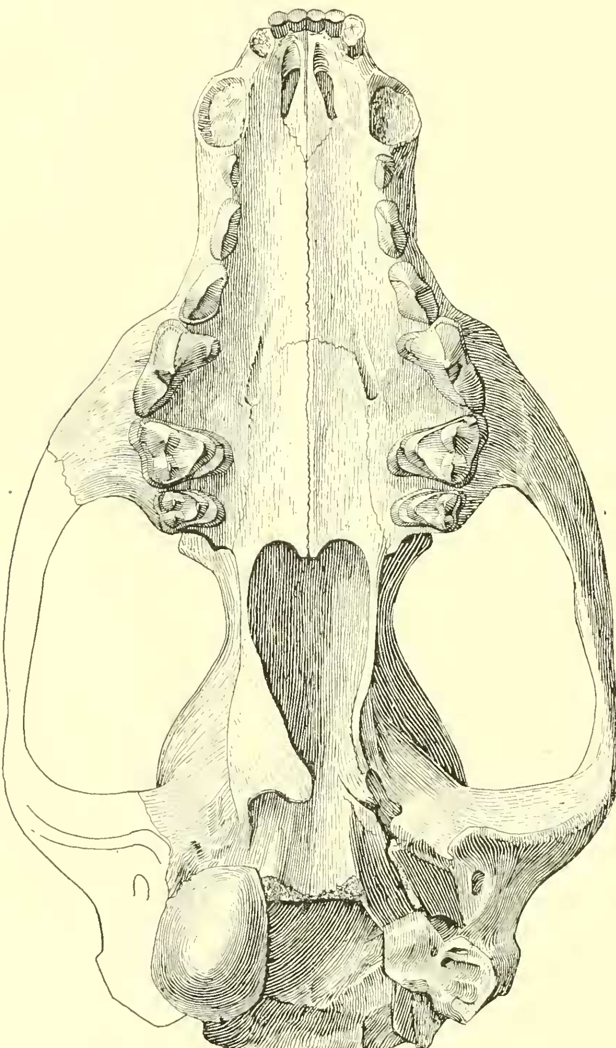

FIG. 10. *Mesocyon drummondanus*. Same individual as Fig. 9. Palate view. Natural size.

The auditory bulla is lost on one side and present on the other. This lends weight to the probability that the absence of the bullæ in some of the skulls of fossil dogs does not prove that the animals did not possess them in life.

MEASUREMENTS.

	Mm.
Length of skull to posterior of tympanic bulla	133
Width of skull, including zygomatic arches, greatest	80
Width at postorbital constriction	23
Length of molar-premolar series	51

ARTIODACTYLA.

LEPTOMERYX TRANSMONTANUS sp. nov.

No. 726. Fig. 11.

This is larger than *L. evansi* and the teeth more advanced, the infraorbital foramen is a little farther back than in the specimen described by Leidy in his Extinct Mammalian Fauna. It opens

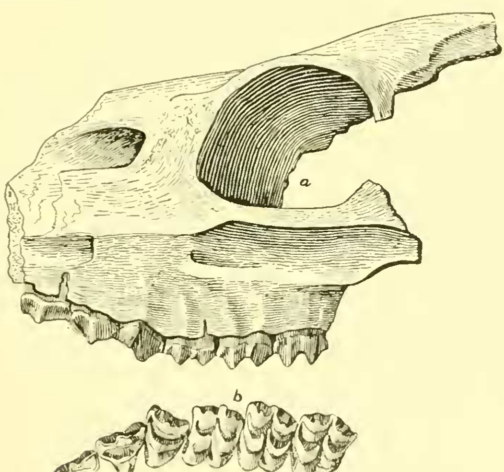

FIG. 11. *Leptomeryx transmontanus* (No. 726). John Day, near Drummond. Natural size. *a*, skull; *b*, crown view of teeth.

above the anterior portion of P^3. There is a prominent malomaxillary ridge which extends forward on the face as far at least as the anterior part of P^2.

The teeth, judging by Leidy's figures,[1] differ in several particulars from those of *L. evansi*. In P^2 the deuterocone is connected by a ridge with the posterior portion of the tooth and by a narrow cingulum with the anterior portion. P^3 is the same, except that the deuterocone and the anterior cingular ridge are better developed. Thus the teeth are successively approaching the true ruminant pattern of the fourth premolar, which is fully attained in this species. The median and anterior outer pillars on the molars and the last premolar are not very prominent. The inner and outer crescents of the teeth are not very widely separated, yet the teeth are not so much worn as in the specimen figured by Leidy (Ext. Mam. Fauna, Pl. XIV., Fig. 5).

From the same beds as the specimen last described.

MEASUREMENTS.

	Mm.
Length of molars and last three premolars	41
Length of molar series	22
Length of premolar series	20
Length of P^2	7
Width of P^2	5.5
Length of P^3	7
Width of P^3	6
Length of P^4	6
Width of P^4	7
Length of molars each	7
Width of M^1	8
Width of M^2	9
Width of M^3	8
Height of orbit	21
Length of orbit	24

PROMERYCOCHŒRUS MINOR sp. nov.

No. 769. Fig. 12.

Of this species there is a large portion of a skull and mandible. The upper and posterior portions of the cranium are gone. All the teeth are represented except I^1. It was found near Drummond, on the Hellgate River, in the same beds with *Leptomeryx transmontanus* and *Mesocyon ? drummondanus*.

I refer it provisionally to this genus principally on account of the form and size of the zygomatic arches. It seems to be intermediate

[1] Extinct Mammalian Fauna, of Dakota and Nebraska, Pl. XIV., Figs. 1, 4 and 5.

between *Eporeodon* and *Promerycochœrus*. It is a small species of *Promerycochœrus*, but larger than *Eucrotaphus*.

Dentition. — I– and ^{3} are nearly equal in size, convex anteriorly and flat posteriorly. They are of moderate size. The upper canine is quite high, is flat behind with sharp edges. Near the tip it is triangular with three sharp angles, but nearer the root it is convex anteriorly. There is a concavity running lengthwise of the tooth in front

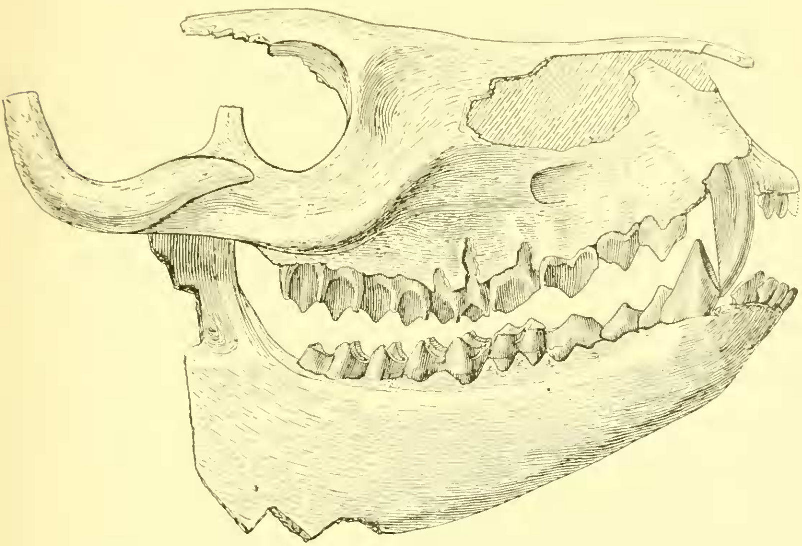

FIG. 12. *Promerycochœrus minor* (No. 769). Upper Oligocene? near Drummond. Half natural size.

of the inner angle, but no high narrow ridge as in *Mesoreodon*. There is a short diastema between this tooth and P^{1}. The latter is narrow and overlaps outwardly P^{2}. Most of the teeth of the molar-premolar series are narrower transversely than in *Mesoreodon*. The anterior and median buttresses on M^{2} and ^{3} are narrow and not heavy.

I_{2} and $_{3}$ have nearly the same size and form, are chisel-shaped, convex on the posterior face, but rather thin antero-posteriorly. I_{3} is larger. The incisiform canine is still larger, triangular in section and overlaps I_{3}, the interior portion of its anterior face being behind the outer portion of that tooth. There is no diastema between the canine and caniniform P^{1}. This premolar is laterally compressed, lenticular in section and sharp-pointed, having been made sharp by the wear on the anterior edge by the upper canine. P^2 overlaps inwardly P^1 about half its length. It also overlaps outwardly P^3.

The teeth might be called brachy-hypsodont. There is a pronounced tendency toward hypsodonty.

The Skull.—I cannot tell whether the premaxillaries were coössified or not, but they are deeper above I^1 than in *Promerycochœrus montanus*. The infraorbital foramen opens above the anterior portion of P^4. The forehead in front of the supraorbital foramina is concave. This is due in part, but, I think, not entirely to crushing. The nasals are long. The preorbital fossæ are not large or deep. The orbit is nearly circular. The zygomatic arch is moderately heavy, but not so much so as in *P. montanus*. The anterior portion below the orbit is not so high as in *P. montanus*, *macrostegus*, and *leidyi*, yet it is higher than in *Eucrotaphus* (*Eporeodon ?*) *superbus*. From its anterior part it expands posteriorly, reaching its maximum expansion a little anterior to the postglenoid process. The outer border is moderately thick and rounded. The posterior portion ascends less steeply than in *P. macrostegus* or *P. superbus*. The longitudinal portion is quite broad and long. The lower border of the malar under the orbit is longitudinally grooved. The bullæ were large, the paroccipital processes small. The lower portion of the latter has three protuberances on its surface, making it quite irregular. The upper portion does not appear to have been much expanded laterally.

MEASUREMENTS.

	Mm.
Length from front of canine to postglenoid process inclusive	185
" of molar-premolar series	105
" of premolar series	49
" of molar series	56
Hight of malar under orbit	24
" of orbit	24
Length of mandible to back of M_3	137
" of lower molar-premolar series	115
" premolar series	55
Depth of mandible under P_4	30

MIOCENE.

FLINT CREEK BEDS.

All the specimens from these beds described below were found near the village of New Chicago, in Granite County.

REPTILIA.

OGMOPHUS ARENARUM sp. nov.

No. 744.

Three vertebræ of a snake from the Flint Creek beds, were associated with many small bones and teeth, among which were the humeri of moles described in this paper.

The vertebræ not so long as broad. Centrum small, with no keel but a broad convexity on lower side. Ball transversely elliptical and facing somewhat upward as well as forward; neural canal arch-shaped with a median ridge or convexity on floor; the articular surfaces of the zygapophyses horizontal; articular surfaces of the zygosphenes quite narrow and facing outward and downward; neural spine low and not reaching to the anterior part of the neural arch; neural arch large and zygosphenes almost as far apart as its width; protuberance for articulation of the rib quite prominent, higher than wide, convex above and in front, and slightly concave on the posterior inferior surface. The interzygapophyseal ridges almost die out midway between the anterior and posterior zygapophyses.

Compared with *O. angulatus* Cope (Tert. Vert., p. 783, Pl. LVIII*a*, Fig. 13) the protuberance for the articulation of the rib is larger, the vertebra proportionally lower, and there is no hypophyseal angle or ridge.

MEASUREMENTS.

	Mm.
Length of centrum of vertebra	4
Width of vertebra	5

MAMMALIA.

INSECTIVORA.

TALPA? PLATYBRACHYS sp. nov.

Type No. 728. Fig. 13.

In the same beds as the preceding (No. 744), associated with scattered teeth and bones of rodents and other small animals, four humeri of moles were found belonging to the same or closely related species. One of these is nearly complete and I take it as the type of the species.

The humerus is smaller than the corresponding bone of *Scalops aquaticus*. It differs from it in having a narrower shaft, in this respect more resembling *Talpa meyeri* of Schlosser. There is a large surface for the articulation of the clavicle. This is convex dorso-ventrally. From the upper outer border a minute point projects outward. This is not nearly so well developed as in *Scalops aquaticus*. The condyle

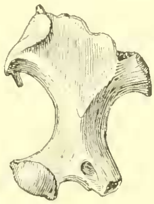

FIG. 13. Humerus of *Talpa ? platybrachys* (No. 728). Twice natural size.

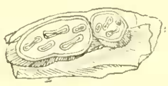

FIG. 14. *Mylagaulus paniensis* (No. 844). Flint Creek beds. $\frac{3}{2}$ natural size

or the scapula forms a quite high crescent-shaped ridge. The ridge for the insertion of the *pectoralis major* muscle is well developed on the inner part of the humerus, but does not extend anywhere near so far outward as in *Scalops*.

MEASUREMENTS.

	Mm.
Length of humerus	13
Width of proximal portion of humerus	11
Width of distal portion of humerus	8

RODENTIA.

MYLAGAULUS PANIENSIS? Matthew, Bull. Am. Mus. Hist., Vol. XVI., p. 299, 1902.

No. 844. Fig. 14.

A portion of a lower jaw containing the large premolar and one molar was found in the Flint Creek beds. This and the type have nothing in common except the premolar, but there is no essential difference in the two teeth. This individual was evidently somewhat younger than the type, as the premolar tooth is higher and the anterior outer enamel lake is longer.

There is one and only one prismatic molar, which was evidently persistent, as it is nearly or quite as high as the premolar. There is in this specimen no trace of a molar posterior to it. The upper surface is subcircular, approaching a pentagon. There are four enamel lakes, two inner and two outer, but these are more oblique than in the premolar, inclining outward and forward.

The one persistent molar as distinguished from two that were often shed in older animals distinguishes this specimen from *M. monodon* and *M. ballensis*.

Found in Flint Creek beds near New Chicago, Mont.

MYLAGAULUS.

Isolated teeth. No. 732. Fig. 15.

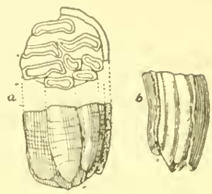

FIG. 15. *Mylagaulus* (No. 732), Flint Creek beds. Showing structure of teeth. Twice natural size. *a*, a premolar tooth; *b*, a molar tooth.

A tooth, probably an upper premolar, from the Flint Creek beds, has the outer enamel well broken away, so that the structure of the tooth can be plainly seen. The enamel lakes which appear on the worn upper surface of the tooth are the tops of compressed enamel tubes which are closed at the bottom.

These tubes are transversely striated. See Fig. 15, *a*. A molar tooth, Fig. 15, *b*, shows the same structure.

The molar shows eight enamel lakes in four rows. Same locality as the preceding.

CARNIVORA.

ÆLURODON? BRACHYGNATHUS sp. nov.

No. 752. Fig. 16.

This is represented by a large part of a mandible and some portions of the upper jaw with all the teeth broken.

As indicated by the remains, the leading characteristics that distinguish this from all other dogs are the following: Face and horizontal portion of mandible greatly shortened yet without reduction in size or number of lower teeth. Mandible deep and robust. Especially heavy in region of symphysis. Teeth crowded and $P_{\overline{2}}$ and $_{\overline{3}}$ set obliquely in the jaw.

The dental formula in the lower jaw and undoubtedly in the upper is the same as that of the modern dogs (*C. lupus*, etc.). The greater portion of the premaxillaries and small portions of the maxillaries show that for the length of the face the nasal region was broad, the anterior palatine foramina large. Incisors 2 and 3 were large; the canine medium sized. $P^{\underline{1}}$ one-rooted, but not very small. The corresponding teeth of the lower jaw evidently had similar proportions.

The lower canine was set diagonally in the jaw. This is true of *C. lupus*, but not to so great an extent, the anterior face of the tooth presenting nearly as much outward as forward. The larger axis of the root of $P_{\overline{1}}$ is in the same direction. $P_{\overline{2}}, _{\overline{3}}$ and $_{\overline{4}}$ have each a larger posterior root and a smaller anterior one. The anterior in $P_{\overline{2}}$ and $_{\overline{3}}$ is partly exterior to the posterior. The roots are closely

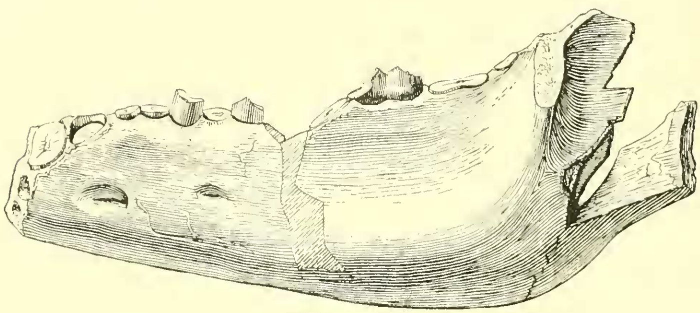

FIG. 16. *Ælurodon ? brachygnathus* (No. 752). Flint Creek beds. Natural size.

crowded. The heel of the lower sectorial is mostly preserved, yet it is injured so that one cannot be certain whether the pattern is more like that of *Temnocyon* or of *Canis*.

There are two mental foramina, a larger under $P_{\overline{2}}$ and a smaller one on a higher level beneath the anterior part of $P_{\overline{4}}$. The posterior portion of the lower border of the mandible in front of the angle is very convex antero-posteriorly. The anterior ridge of the ascending ramus in front of the masseteric fossa is large and high and the fossa deep.

MEASUREMENTS.

	Mm.
Length of molar-premolar series	58
Depth of mandible under $P_{\overline{1}}$	19
Depth of mandible under $P_{\overline{2}}$	28

SUIDÆ.

HESPERHYS gen. nov.

No. 748. Fig. 17.

Mandible short and heavy. Teeth uninterrupted except a short diastema between the canine and the anterior premolar. Inferior dental formula I_3, C_1, P_3, M_3. Premolars $_2$ and $_3$ simple conical cusps. M_3 with a heel composed of several small cusps.

HESPERHYS VAGRANS sp. nov.

No. 748. Fig. 17.

The type of the genus and species is a large portion of a lower jaw exclusive of the ascending rami. It was associated with the bones of *Procamelus* in the Flint Creek beds. There are also some fragments of the skull.

I_2 is large and chisel-shaped. Near the root its antero-posterior is much greater than its transverse diameter. On its anterior face it is convex and on its posterior face concave with a median longitudinal

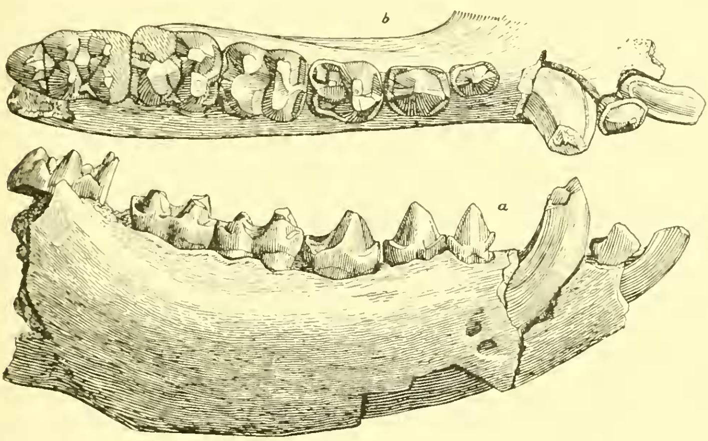

FIG. 17. *Hesperhys vagrans* (No. 748), Flint Creek beds, ½ natural size. (*a*) Right ramus of mandible. Partly restored from the other side. (*b*) Crown view of teeth of the same. All the lower teeth are represented except the first incisor.

convexity. I_3 is low-crowned, conical, with a prominent inner cingulum. The canine is three-sided, the posterior side being nearly flat. It is slightly curving and points outward more than forward. P_2 and P_3 are high pointed, simple conical cusps with heavy cingula. P_3 is much larger than P_2. In P_4 the anterior portion is partly divided as if another large cusp had grown up outside of the protoconid. There is also a heel, but the tooth is not at all molariform. All the molars have four principal tubercles, but by the addition of intermediate tubercles they increase in complexity backward. $\underline{M}^3$ has a heel composed of one principal tubercle and three smaller ones. Not having access to the types I cannot be certain that this may not belong to some one of the Suidæ described but can find no descriptions that correspond to it.

MEASUREMENTS.

	Mm.
From front of $I_{\overline{2}}$ to back of $M_{\overline{3}}$	178
Depth of mandible under $M_{\overline{2}}$	50
Thickness of mandible under $M_{\overline{2}}$	31
Length of molar-premolar series	126
Length of premolar series	48
Length of molar series	78
Length of $P_{\overline{2}}$	12
Width of $P_{\overline{2}}$	9
Length of $P_{\overline{3}}$	16
Width of $P_{\overline{3}}$	12
Length of $P_{\overline{4}}$	20
Width of $P_{\overline{4}}$	16
Length of $M_{\overline{1}}$	23.5
Width of $M_{\overline{1}}$	19.5
Length of $M_{\overline{2}}$	23.5
Length of $M_{\overline{3}}$	31

From Flint Creek beds near New Chicago.

OREODONTIDÆ.

POATREPHES PALUDICOLA gen. et sp. nov.

No. 845. Fig. 18.

A skull of an Oreodont found in the Flint Creek beds near the village of New Chicago is different from any other member of the family with which I am acquainted. The principal distinguishing characters are the following:

Skull elongated, not shortened as in *Merychyus* and *Merycochœrus*. Posterior portion of skull including occiput broad, zygomatic arches broad, heavy and spreading anteriorly, mastoid processes greatly expanded laterally, tympanic bullæ large but not rounded as in *Eporeodon*, external auditory meatus forming a large wedge. Teeth brachy-hypsodont, molars narrow transversely.

To these may be added with a slight doubt: Large prelachrymal vacuities; crest of occiput not much overhanging, premaxillaries not coössified. As the skull is somewhat mutilated and distorted I would not be too positive about there being prelachrymal vacuities, but if not, there were certainly prelachrymal pits. On one side there is a large circular space anterior to the orbits which has no bone and the surrounding bone, in part, appears to be unbroken.

The skull is a little longer than that of *Mesoreodon chelonyx* Scott. The nasals are lost. The malomaxillary ridge is high, very convex, extends upward as well as forward, dying out near the upper border

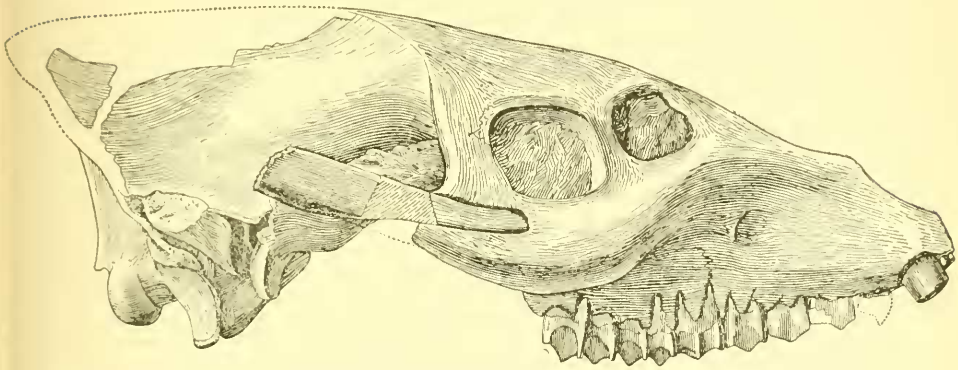

FIG. 18. *Poatrephes paludicola* (No. 845). Flint Creek beds. One half natural size. Right view of skull, part of teeth restored from other side.

of the maxillary just in front of the lachrymal depression or vacuity. The anterior borders of the premaxillaries are thick and they do not rise so abruptly as in *Mesoreodon* or *Eporeodon*. The prelachrymal vacuities appear to have been quite large. The sagittal crest was high as shown by impression on surrounding matrix. The anterior portion of the zygomatic arch beneath the orbits is broad, heavy, and widely spreading, the outer portion curving downward, with the border roughened and very concave antero-posteriorly. The anterior lower root is low, being only a little above the alveolar border. The orbit is closed behind by a heavy bridge of bone. The anterior tongue of the squamosal is long and slender, terminating beneath the posterior portion of the orbit. This process and the posterior process of the jugal overlap for a considerable distance. From opposite the glenoid surface the zygomatic arch ascends slightly to where it is broken off opposite the glenoid process. The anterior portion of the arch is broad and thick. It spreads far outward from the molars. The posterior portion beneath is convex from the glenoid surface to the outer border. The glenoid surface is convex both antero-posteriorly and transversely. The post-glenoid process is broad transversely but not very thick.

The external auditory meatus is enlarged into a pyriform or wedge-shaped mass of bone with the apex pointing downward. Where this meatus is joined to the auditory bulla this process does not extend downward so far. The tympanic bullæ are large but not symmetrically rounded as in several of the Oreodonts. They differ on opposite sides of the same skull, and one is larger than the other. One is approximately a quarter of a four-sided pyramid, with the apex pointing downward. The other approaches nearer to a cube. Posteriorly the broad spout-shaped paroccipital processes clasp the bullæ closely, as if accommodating themselves to the forms of the bullæ. The paroccipital processes are rather thin antero-posteriorly, are concave in front and convex — nearly angulate — behind, but are much expanded laterally, as in *Merycochœrus laticeps*. The basi-occipital has a median ridge between the tympanic bullæ which widens as it approaches the occipital condyles. These condyles are small. Above the foramen magnum is a very convex median ridge bounded laterally below by two deep concavities.

The two anterior incisors, judging by the remains of the alveoli, were small, the third much larger. The canine was of medium size. Premolar four and the molars have extremely narrow valleys, but the teeth are much worn. The molars are narrow with no ridges on the outer median surfaces of the outer crescents. On the third molar the anterior and median pillars are prominent but there is no large accessory lobe at the postero-exterior angle, though there is a small one.

MEASUREMENTS.

	Mm.
Length of skull along palate, etc.	225
Length of face from posterior margin of orbit	122
Width of skull at glenoid surface	152
Width of skull at orbits	155
Breadth of palate at same place, including molars	74
Length of upper molar-premolar series	96
Length of upper premolar series	50
Length of upper molar series	46
Width of M^2	18

POATREPHES?

No. 754.

In the summer of 1898 my traveling companion, Mr. Wm. T. Coffey, found in the Deep River beds near White Sulphur Springs a last premolar and three molars, with part of the maxillary of an Oreodont which probably belongs to this genus. It was found with part of a skeleton of *Palæomeryx* and the incisors of some horse-like animal. The parts preserved differ very little from the teeth of the animal above described.

MERYCHYUS SMITHI sp. nov.

No. 766. Fig. 19.

Of this species there is the lower portion of the right side of the skull with parts of the mandible. The upper molar-premolar series is present and the lower series back of $P_{\overline{2}}$. The jaws have not been

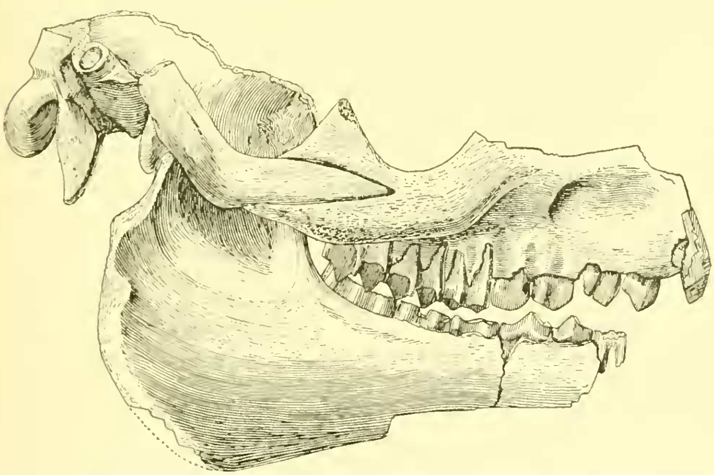

FIG. 19. *Merychyus smithi* (No. 766). Flint Creek Beds. One half natural size. Part of mandible restored from other side.

separated and the grinding faces of most of the molars are still hidden.

The teeth are of the brachydont pattern and are much like those of *Poatrephes paludicola*, the species just described.

The upper canine was large. P^2 is two-rooted and separated from the canine by a short space. $P_{\overline{3}}$ and $P_{\overline{4}}$ are of the usual Oreodont pattern.

The skull, especially the facial portion, is short. The malar portion of the zygomatic arch is heavy and its lower border has two rounded angles. If the post-orbital processes of the jugal and frontal united at all they must have formed a very narrow bridge behind the orbit. The squamosal portion of the zygomatic arch rises quite abruptly from a little behind the malar. On the postero-inferior portion of this ascending portion is a long elliptical rugose convexity.

The *meatus auditorius externus* is peculiar. It opens backward, outward and upward, the outer portion being a short, large tube. Inward from this it is wedge-shaped, something like that in *Poatrephes*, but in this specimen the apex is turned forward and fits closely against the horizontal portion of the zygoma and the posterior portion of the post-glenoid process. It is possible that in one of these specimens the meatus is slightly displaced. There undoubtedly was a tympanic bulla, but it is lost. The paroccipital process has much the same form as in *Poatrephes*, but is not so broad. The occipital condyles and the foramen magnum are large. The orbit is large. The infraorbital foramen opens above $P^{\underline{3}}$.

The portion of the mandible preserved is much like that of *Eporeodon*. The lower border of the mandible slopes gradually backward to the angle. The masseteric fossa does not extend so far down.

MEASUREMENTS.

	Mm.
Length of upper molar-premolar series	88
Length of premolar series	43
Length of molar series	45
Depth of zygomatic arch under orbit	20
Width of auditory meatus antero-posterior	20
Width of paroccipital process	21
Width of occipital condyles	43
Width of foramen magnum	21
Depth of mandible under anterior portion of third molar	38

The name of this species is given in honor of my friend, Prof. F. D. Smith, who so kindly gave aid and encouragement in the collecting of fossils from these beds.

MADISON VALLEY BEDS.

PISCES.

No. 857. Fig. 20.

The only evidence of the occurrence of fish remains in this formation is the centrum of one of the anterior vertebræ. It represents a large fish. It was found in the beds of sand and gravel about nine or ten miles south of Logan.

	Mm.
Length of centrum	21
Width " "	19

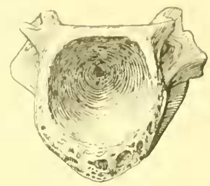

FIG. 20. Vertebra of fish (No. 857). Loup Fork, Lower Madison Valley. End view, natural size.

MAMMALIA.

RODENTIA.

SCIURUS sp.

No. 746. Fig. 21.

Part of a left mandibular ramus from the Loup Fork of the Lower Madison Valley.

This is about the size of the corresponding jaw of the black squirrel. The most noticeable peculiarities are the prominence of the ridge for the attachment of the inner part of the *masseteris lateralis* muscle, the anterior position of the anterior angle of the masseteric fossa, the length of the mandible anterior to the molars, and the anterior position of the mental foramen. The lower border of the anterior portion of the jaw as far back as the beginning of the angle is the arc of a circle.

The length of the molar-premolar series is less than in *S. vortmani*, and the mandible is not so deep. The premolar is the smallest tooth of the series, and the molars are nearly equal in size. The teeth are oblique as in *Arctomys*.

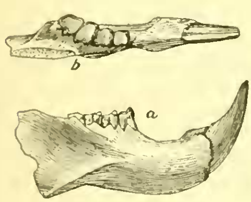

FIG. 21. *Sciurus* sp. (No. 746). Loup Fork, Madison Valley. Natural size.

MEASUREMENTS.

	Mm.
Length of incisor to back of M_3	24
Length of molar premolars	9

SCIURUS ARCTOMYOIDES sp. nov.

No. 741. Fig. 22.

A small portion of a skull with the incisors and three anterior cheek teeth and the greater part of a mandible. It was with the skeleton of *Palæarctomys montanus* in the Loup Fork beds of the Lower Madison valley.

The upper incisors have a slight median longitudinal depression on the anterior surface, which is also covered with minute interrupted striations. The anterior premolar is minute. The last premolar is many times larger but not nearly so large as M^1. The teeth are intermediate between those of *Sciurus* and *Arctomys*, rather more resembling some species of the former. On P^4 and M^1 the three cross-crests are very distinct and the posterior cingulum is well developed. From the Loup Fork beds, Lower Madison Valley.

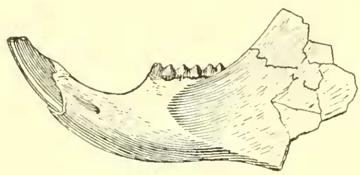

FIG. *Sciurus arctomyoides* (No. 741). Lower Madison Valley. Natural size.

The lower incisor is laterally compressed and has minute striations on the anterior face, like the upper ones. $P_{\overline{4}}$ is smaller than any of the molars and has four tubercles. $M_{\overline{1}}$ and $M_{\overline{2}}$ have four tubercles each and minute inner and outer intermediate ones. The teeth are oblique, as in *Arctomys monax*, only not so much so. All the molars are nearly of the same size. The mental foramen is placed quite far forward, being considerably in advance of the premolar. The anterior angle of the masseteric area is higher than in *Arctomys* and extends far forward, being a little below the premolar.

MEASUREMENTS.

	Mm.
Length of the anterior upper cheek teeth	8
" of last premolar	3
Width of last premolar	3.3
Length of lower molar-premolar series	16
" from incisor to P^4	12
Depth of mandible under $M_{\overline{1}}$	12

PALÆARCTOMYS gen. nov.

No. 740. Fig. 23.

Teeth nearly like those of *Arctomys*, but small in proportion to the size of the skull. Incisors large and strong, with many minute interrupted longitudinal striations and two or more larger convex ridges separated by shallow longitudinal furrows on the anterior faces. Skull large and strong anteriorly, in this respect differing much from *Sciurus* and *Arctomys*. Temporal ridges uniting farther forward at a greater angle than in *Arctomys monax*. The most peculiar characteristic is the presence of two chambers opening posteriorly between the posterior nares and the posterior portion of the palate. I have not observed this in any other animal.

Palæarctomys montanus is the type of the genus.

PALÆARCTOMYS MONTANUS sp. nov.

No. 740. Fig. 23.

This species is represented by a large part of a skeleton found in the same beds as *P. macrorhinus*. The skull is longer in the present species. The upper incisors have more longitudinal ridges on the anterior faces; the transverse dmeiater is somewhat less and teeth are

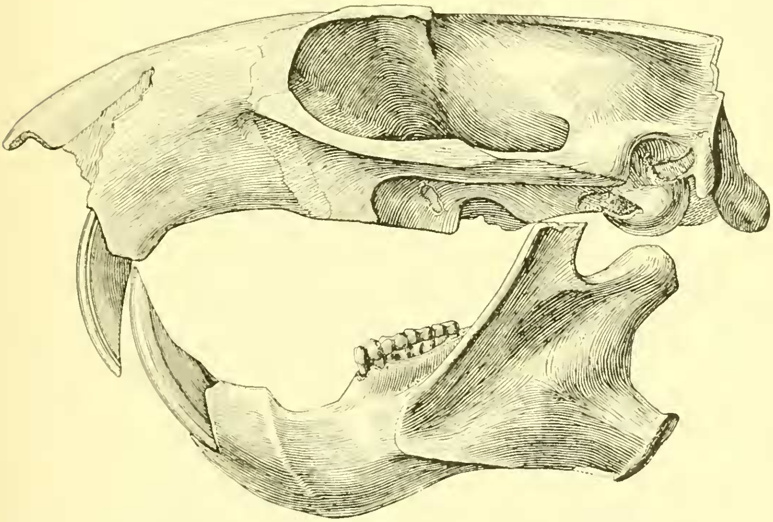

FIG. 23. *Palæarctomys montanus* (No. 740). Lower Madison Valley. Skull and mandible. Natural size.

longer, *i. e.*, they project farther from the jaws. The skull does not differ greatly from that of *Arctomys monax* so far as shown except in what, for convenience, I will call the *post-palatine* cavities, and in the size of the muzzle. The incisors are very much larger than in that species. Not all of the skull is preserved.

The mandible resembles that of *Arctomys*, but is very much more robust. This is especially noticeable in the anterior part, where it is very heavy, and in the condylar process. The symphyseal suture is large. The anterior part of the jaw is farther strengthened by a ridge which passes from the upper part of the symphyseal suture obliquely around the outside of the jaw backward and downward to the chin. The anterior border of the coronoid process slopes upward and backward uniformly, in a nearly straight line, to near the tip, where it is broken off. The lower teeth are much smaller than those of *Arctomys*. The other parts of the skeleton so far as preserved are much like those of *Arctomys*.

MEASUREMENTS.

	Mm.
Length of skull	100
Length from anterior of incisors to posterior of zygomatic arch	78
Width of skull at post-orbital constriction	21
Depth of snout just anterior to anterior root of zygomatic arches	27
Depth just back of incisor	25
Width just back of incisor	32
Antero-posterior diameter of upper incisors	9
Transverse diameter of upper incisors	4.5
Length of mandible including incisor	70
Length of lower molar-premolar series	15.5
Depth of mandible of middle of symphysis	14.5

PALÆARCTOMYS MACRORHINUS sp. nov.

No. 733. Figs. 24 and 25.

The type of this species is a skull, lacking the nasals and the posterior portion of the cranium. The skull is very robust and about the

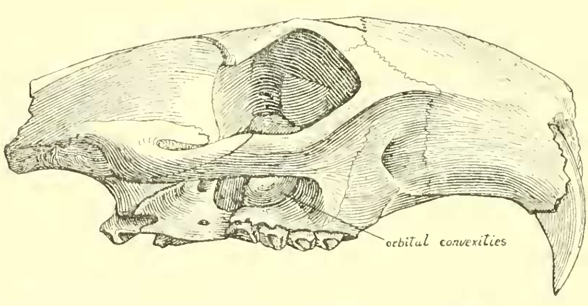

FIG. 24. *Palæarctomys macrorhinus* (No. 733). Lower Madison Valley. Skull from right side. Natural size.

size of that of *Arctomys monax*, but the region in front of the orbits is very much deeper and wider. The incisors are also much larger.

Each has three longitudinal convexities on the inner face, also many minute wrinkles or discontinuous striations covering these.

The cheek teeth seem ridiculously small for such a large, robust skull. It seems that the animal was particularly fitted for gnawing, as *Mylagaulus* was for grinding or breaking hard substances. The third premolars (the first of the back teeth) are both shed, but the alveoli show that they each had but one small root.

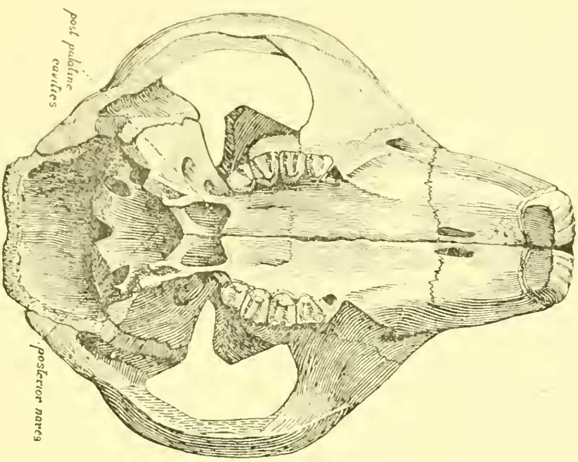

FIG. 25. Same as 24. Lower view of skull. Natural size.

The infraorbital foramina are vertical slits opening at the anterior roots of the zygomatic arches nearer the orbits and higher than in *Arctomys*. Above the molars and inside the zygomatic arch at the lower portion of the orbital fossa is a large convexity. Another is placed above and in front of it. At the posterior portion of the palate is another peculiar structure. There are two cavities between the posterior portion of the palate and the opening of the posterior nares. I am unable to determine in just what proportion the palatines and pterygoids enter into the formation of these cavities. The form is very well shown in the figure. They extend forward a short distance above the posterior portion of the palate. Whether they open anteriorly into the posterior nares is not quite certain, but if so the opening is small. The roof is thin. The posterior border is thick, rounded, and V-shaped. There is a thin partition partly separating these cavities. The posterior opening of the nares is about the same size as in *Arctomys*, but it opens more downward, as the basisphenoid is more steeply inclined.

MEASUREMENTS.

	Mm.
Length of skull to posterior portion of zygomatic arch	63
Width of skull between orbits	30
Greatest width of skull including zygomatic arches	60
Depth of skull at anterior beginning of zygomatic arches	22
Width of palate between first molars	15
Length of molar-premolar series	16
Antero-posterior diameter of upper incisor	7
Transverse diameter of upper incisor	5

MYLAGAULUS COPE.

Several lower jaws and teeth of Mylagaulidæ from the Loup Fork of Montana throw considerable light on the tooth structure and the development of the characteristic dentition of this family. No skulls were found, but the upper dentition undoubtedly kept pace approximately with the lower. This is true of the species *Ceratogaulus rhinoceros* Matthew, and *Mylagaulus lævis* Matthew in the American Museum of Natural History.

The specimens here described may not all belong to the genus *Mylagaulus*, but they undoubtedly belong to the same family. I think it better to include all under *Mylagaulus* until more complete material is found.

In one specimen (*M. pristinus*) the erupting large premolar was apparently pushing out with its posterior portion a short-crowned, long-rooted tooth. Its anterior portion is replacing a tooth only a portion of one root of which remains. In two other specimens the large premolar has missed this short-crowned, rooted tooth ; or the anterior portion of the latter has apparently been absorbed and its posterior portion still remains between the large premolar and the first prismatic molar.

There can be little doubt that this last rooted tooth is a *milk molar*. It is not at all prismatic, has long roots, is much worn in the young animal, and in one case is being shed. The permanent premolar and the two permanent molars are prismatic. In the descriptions which follow, the rooted tooth above described will be designated as the fourth temporary molar, $dm_{\overline{4}}$. If the above conclusions be true the large, permanent, prismatic premolar replaces two temporary molars.

In one specimen the posterior inner root of dm_3 is still preserved in place.

It appears, then, that the young of *Mylagaulus* has two milk molars. If all described below belong to *Mylagaulus* at a certain stage during the life of the animal, there are two milk molars and two permanent molars ; while in some cases in old age there is only one tooth to take the place of all these — a large premolar. Thus it is not improbable that some individuals which had twenty teeth at one time of life were finally reduced to four.

The molar that is wanting in the adult animal is apparently the first, as there is no evidence of the loss of M_3. The development of the first molar is evidently prevented by the large, permanent premolar. Perhaps under favorable conditions rudiments of M_1 might be found.

MYLAGAULUS ? PRISTINUS sp. nov.

No. 742. Fig. 26.

Mandible robust. Anterior and posterior angles widely separated, the former extending far below the lower border of the horizontal ramus and rounded, the latter oblique, high and projecting laterally far outward. Permanent premolar large, very high, and with short roots. The fourth temporary molar, which is retained in the present specimen, is short, low, and has long roots. Molars $\overline{2}$ and $\overline{3}$ are of moderate size and hypsodont. The enamel inflections and lakes on the last temporary premolar and the two molars are either antero-posterior or oblique.

The large permanent premolar, though quite young, is somewhat worn on the grinding surface. It has six enamel inflections, most of which are oblique. To ascertain the form of the enamel pattern farther down, the tooth was sawn in two about half way from the top of the crown to the root. Here, as shown in Fig. 26, *c*, the pattern is exactly that of *Mylagaulus*. There are five approximately longitudinal lakes in three rows, as in *M. paniensis*.

$M_{\overline{2}}$ is nearly worn out. It is closely crowded against the premolar, and on the anterior portion next to this tooth the enamel is absent. Like the corresponding tooth in specimen No. 723, to be described later, it looks as if the anterior portion of the tooth has been absorbed. If the animal had lived the tooth would evidently soon have been shed. $M_{\overline{2}}$ is prismatic and quite high though its lower portion cannot be seen. $M_{\overline{3}}$ cannot be very high on account of its proximity to the posterior portion of the incisor. It is undoubtedly much like the corresponding tooth of No. 723.

It is possible that in old age one or both of these molars were shed, leaving only the prismatic premolar, as seen in *M. monodon*, or this tooth and $M_{\overline{2}}$ as in *M. paniensis ?*

This species differs from *M. monodon* in the size of the permanent premolar, in the number of enamel inflections, in the angle of the mandible, and in the condyle. The posterior angle is not just like anything I know in any rodent. It projects outward and is twisted

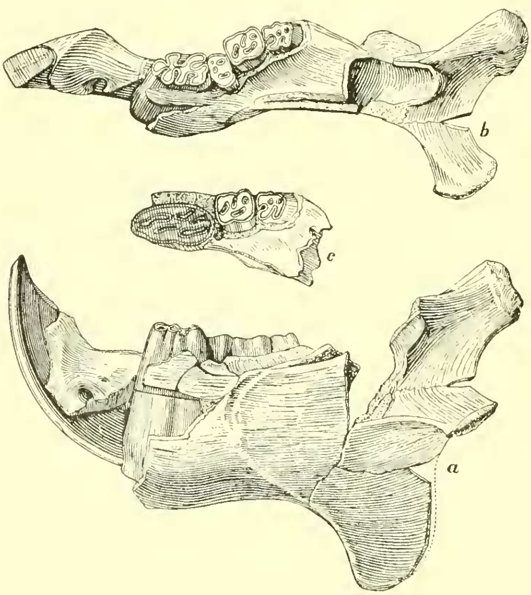

FIG. 26. *Mylagaulus? pristinus* (No. 742). Lower Madison Valley. Left ramus of mandible. $\frac{3}{2}$ nat. size. *a*, side view; *b*, the same, top view showing crowns of teeth; *c*, the same showing section of $P_{\overline{1}}$ at place indicated in *a*, where the tooth was sawed in two.

on itself so that anterior surface faces upward and forward more than outward. This terminates in a lenticular-shaped surface facing downward, backward and outward.

MEASUREMENTS.

	Mm.
Length of mandible from anterior of incisor to posterior of condyle	45
Length of back series of teeth.	13.5

Depth of mandible at prismatic premolar	13
Depth of mandible from top of condyle to bottom of angle	30
Height of premolar	14
Length of premolar at alveolar border	6
Length of $M_{\overline{2}}$	4
Width of $M_{\overline{2}}$	3
Length of $M_{\overline{3}}$	3
Width of $M_{\overline{3}}$	2.5

Found in bluffs of Lower Madison valley, Montana.

MYLAGAULUS PROXIMUS sp. nov.

No. 842. Fig. 27.

Part of a mandible with the anterior portion and the angle gone. It is smaller and less robust than the corresponding part of *M. proximus*, not being so deep, so thick, or so long. The condyloid process is shorter and not so broad antero-posteriorly, and the articular process is broader transversely. This is a somewhat younger animal than the preceding.

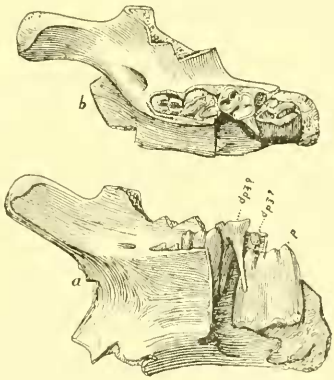

FIG. 27. *Mylagaulus proximus* (No. 843). Lower Madison valley. $\frac{3}{2}$ natural size. *a*, inner view of portion of mandible. The large permanent premolar eruption. *b*, the same, upper view; *p*, permanent premolar; dp_3, dp_4, temporary molars.

When the animal died the large permanent premolar was erupting and had nearly reached the alveolar border. This tooth, being much larger than its two predecessors, the portion of the jaw containing the roots of the latter had to be absorbed. A small part of this alveolar portion, with one root of the anterior temporary molar remains above the postero-external portion of the large premolar. The last temporary molar being unreduced in antero-posterior diameter was being pushed out by this new tooth. This last temporary molar has a larger grinding surface than that of *M. proximus*, but is low, nearly worn out, and has two long slender roots.

P_4 is not as large, but it would undoubtedly have become larger as there is a considerable space between its posterior border and the anterior border of $M_{\overline{2}}$. This last tooth is long vertically on account of its greater age, longer than the premolar. It appears to be open below and not to have completed its growth. It is very doubtful if this tooth would be shed during the lifetime of the animal. It had not yet come into use, at least it is not worn, though it projects some distance above the alveolar border. $M_{\overline{3}}$ was just erupting. Evidently the two temporary molars and the two permanent ones were about equal in length and width.

MEASUREMENTS.

	Mm.
Depth of ramus under last molar	11
Length of dental series	13
Antero-posterior diameter of immature permanent premolar	6
Length of $dm_{\overline{4}}$ and $ms_{\overline{1}}$ and $_{\overline{3}}$ each	3

Same beds as the preceding.

MYLAGAULUS sp.

No. 723. Fig. 28.

This specimen, which is a portion of a lower jaw, has lost the prismatic premolar, which judging by the inner portion of the alveole,

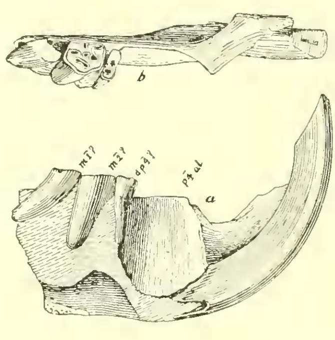

FIG. 28. *Mylagaulus* ? (No. 723). Lower Madison valley. $\frac{3}{2}$ natural size. *a*, portion of jaw showing alveolus of $P_{\overline{4}}$, $dp_{\overline{4}}$? and $M_{\overline{2}}$? $M_{\overline{3}}$? ; *b*, crown view of same, $P_{\overline{4}}$; *al*, alveolus of permanent premolar, $dp_{\overline{4}}$ temporary premolar.

was proportionally as large as in the specimen just described. The last temporary premolar is much reduced, as if by partial absorption, as in the specimen of *M. proximus* (No. 842). Its antero-posterior is half its transverse diameter. The crown is nearly worn down to the roots. $M_{\overline{2}}$ is not so high as in *M. pristinus*. $M_{\overline{3}}$ is still lower. Both the molars might be shed in old age.

MEASUREMENTS.

	Mm.
From front of incisor to back of $_{\overline{3}}$	26
Length of alveolus of permanent premolar	6
Length of dp$_{\overline{4}}$	1.2
Width " "	3

From the Lower Madison Valley.

MYLAGAULUS PANIENSIS?

No. 731. Fig. 29.

A separate permanent premolar (No. 731) found in the lower Madison Valley beds, may belong to the above named species. It is figured to show the partial covering of cement which is quite thick on the middle portion of the tooth, but thins out towards the top, so that the enamel is nearly bare.

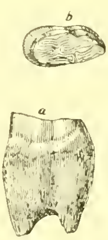

FIG. 29. *Mylagaulus paniensis?* (No. 731). Lower Madison valley. $1\frac{1}{2}$ natural size. *a*, permanent premolar, side view; *b*, same, crown view.

RODENT.

No. 802.

An incisor tooth from the Loup Fork beds of the Lower Madison valley indicates a large rodent —larger than the existing beavers. Judging by its curvature it is an inferior incisor. On the anterior surface there are about a dozen small longitudinal striæ with still smaller cross-striations. The striated enamel surface reaches from the anterior inner angle of the tooth, where it is bounded by a longitudinal groove, to near the middle of the outer surface, where it ends abruptly, this surface being somewhat elevated above the surface just posterior to it. The antero-posterior is much greater than the transverse diameter, making it less near an equilateral triangle in section than the corresponding tooth of the Beaver, *Castor canadensis*.

	Mm.
Antero-posterior diameter of tooth	12
Transverse diameter	8.5
Length of portion of tooth preserved	80

CARNIVORA.

MUSTELA ? MINOR sp. nov.

No. 848. Fig. 30.

The type is a left mandibular ramus, lacking the incisors, the coronoid process and the condyle. It was found in a clay cliff near the bottom of the Loup Fork beds in the Lower Madison Valley. It is smaller than the corresponding part of *M. ogygia* Matthew,[1] being a little over one half the length. The canine is semi-procumbent. There were three premolars. $P_{\overline{2}}$ is lost, but its two minute alveoli can be seen; the anterior one is confluent with that of the canine. $P_{\overline{3}}$ has a rudimentary heel. In $P_{\overline{4}}$ the heel is better developed and there is a small accessory cusp on the posterior outer side of the protoconid. There is also a small anterior rudimentary cusp. The carnassial has a well-developed inner cusp. $M_{\overline{2}}$ was small and set partly in the ascending ramus. The angle of the jaw is nearly like that of the common weasel. The masseteric fossa is very deep.

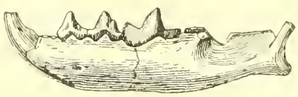

FIG. 30. *Mustela minor* (No. 848). Lower Madison valley. Left ramus of mandible. $\frac{3}{2}$ natural size.

I am in doubt whether this should be placed in the genus *Mustela*, as it differs from most or all of the known species in having only three crowded premolars and having a well-developed metaconid on $M_{\overline{1}}$. There are other slight differences.

DINOCYON OSSIFRAGUS sp. nov.

No. 790. Figs. 31 and 32.

Portions of the skull and teeth of this large carnivor were found in a sandy stratum in the Loup Fork beds of the Lower Madison Valley. Enough of the fragments have been fitted together to give some idea of the great size of the animal. Judging by the parts preserved it was much larger than the grizzly bear, but not quite so large as the cave bear, *Ursus spelæus*. The skull was evidently not less than seventeen inches in length and probably considerably longer. The length of the last upper premolar and the two molars is nearly the same as that

[1] Fossil Mammals from Colorado. *Memoirs Am. Mus. Nat. His.*, Vol. I., Part VII., p. 383, Figs. 8 and 9.

of the corresponding teeth of *Amphicyon major* which is figured in de Blainville's Osteographie.

The face is short and the teeth crowded together without disastemata. The last three premolars are preserved and there appears to have been a small first premolar. A part of the posterior portion of

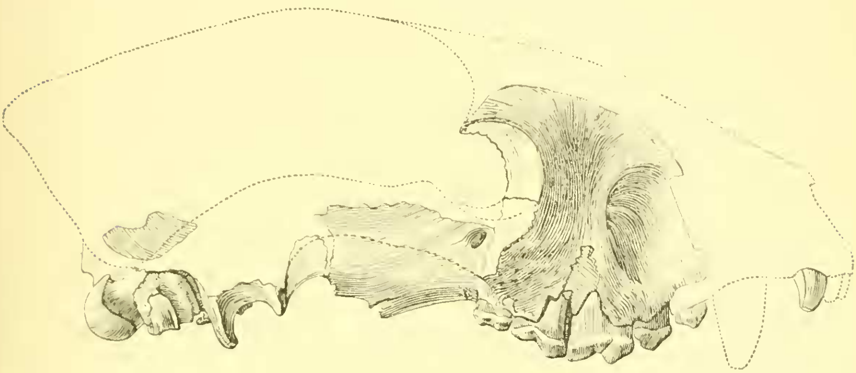

FIG. 31. *Dinocyon ossifragus* (No. 790). Lower Madison valley. One fourth natural size.

the alveolus of the canine is present and is but a slight distance in front of P^{2}. What appears to be a small portion of the alveolus of P^{1} is also preserved, but it must have been small and crowded between the canine and P^{2}. The posterior portion of the skull, especially the mastoid portion, is massive. The mastoid and postglenoid process are bear-like, while the teeth have the general pattern of those of the dogs, but are low, strong, blunt, and simple, as if formed for grinding and crushing rather than for cutting. The worn condition of the teeth shows further evidence of this.

There is a deep concavity in the face posterior to the root of the canine and anterior to the infraorbital foramen. The foramen opens into this concavity. It is above P^{4}, is oblong-elliptical, and opens forward and upward.

Just above the foramen magnum the occipital projects backward and is separated into two lateral concavities by a deep median groove. The occipital condyles are broad and the articular faces quite widely separated below although this character is not shown in the figure. The basioccipital has a sharp narrow median ridge and there are two lateral convexities about one inch forward of the condyles.

The dental formula, as previously indicated, was probably $I\frac{3}{}$, $C\frac{1}{}$, $P\frac{4}{}$, $M\frac{2}{}$, though possibly there were but three premolars.

The third incisor — the only one preserved — is caniniform, and posteriorly there is a groove worn by contact with the lower canine. $P\frac{2}{}$ is oblong, the apex being anterior to the middle. $P\frac{3}{}$ is much longer and the posterior portion is broader than the anterior. $P\frac{4}{}$ has no anterior inner cusp, but there is a broadening of the crown with a

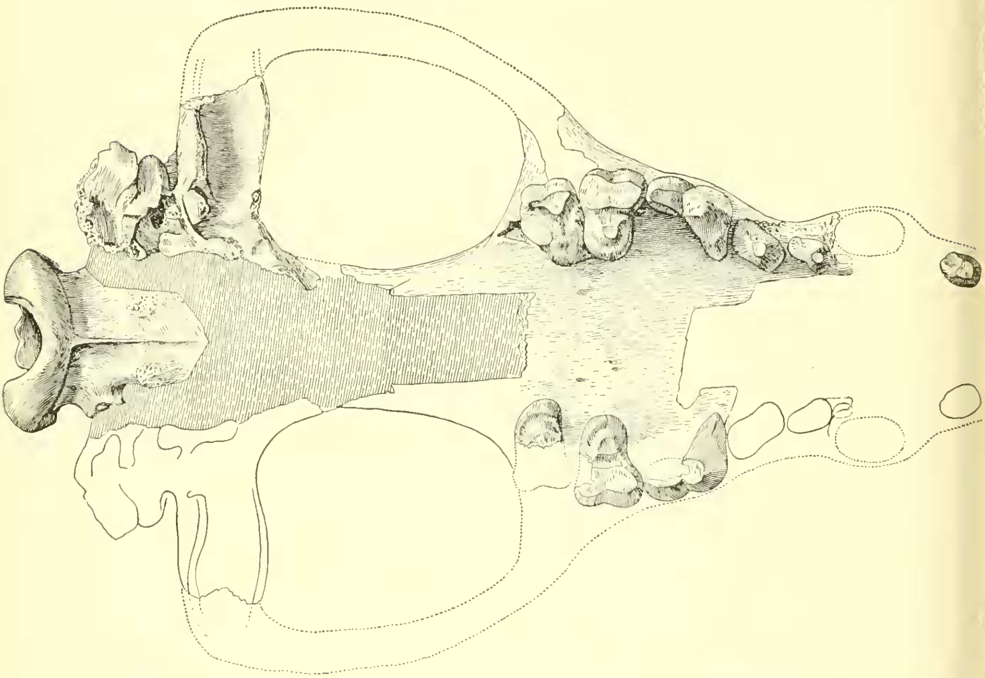

FIG. 32. *Dinocyon ossifragus* (No. 790). Loup Fork, Lower Madison valley. $\frac{1}{3}$ natural size.

gentle slope to accommodate the inner root. $M\frac{1}{}$ is broad, its transverse being far greater than its antero-posterior diameter. The outer cusps are worn down to two slightly convex areas. The inner cusp is low and crescent-shaped. The inner cingulum is broadest and most prominent postero-internally to the inner cusp, where it forms a large evenly convex ridge. The second molar on the right side does not appear to be a normal tooth.

I include this provisionally under *Dinocyon* on account of the number of upper molars, and the shortness of the face.

MEASUREMENTS.

	Mm.
Length of the last 3 premolars and the 2 molars	126
Length of P^2	17
Width " "	11
Length of P^3	23.5
Width " "	15
Length of P^4	35
Width " "	23
Length of M^1	30
Width " "	41
Width of occipital condyles	72
" " foramen magnum	28

PERISSODACTYLA.

APHELOPS? CERATORHINUS sp. nov.

No. 857. Figs. 33, 34 and 35.

Part of the skull, mandible and limb bones of one individual were found together, in the Lower Madison valley, about five miles south of the town of Logan. Other portions of skeletons were obtained

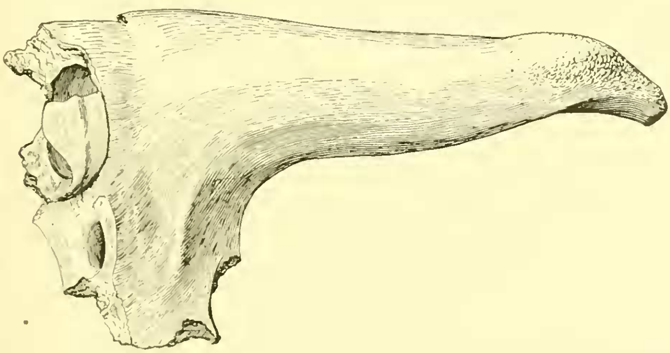

FIG. 34. *Aphelops? ceratorhinus* (No. 857). Nasals. Loup Fork. $\frac{1}{3}$ natural size.

which may belong to the same species, but they are not now accessible.

Size large. Nasals long, heavy, and horn-bearing. Molars and P^4 with anterior process to posterior cross-crests. P^1 small, the others

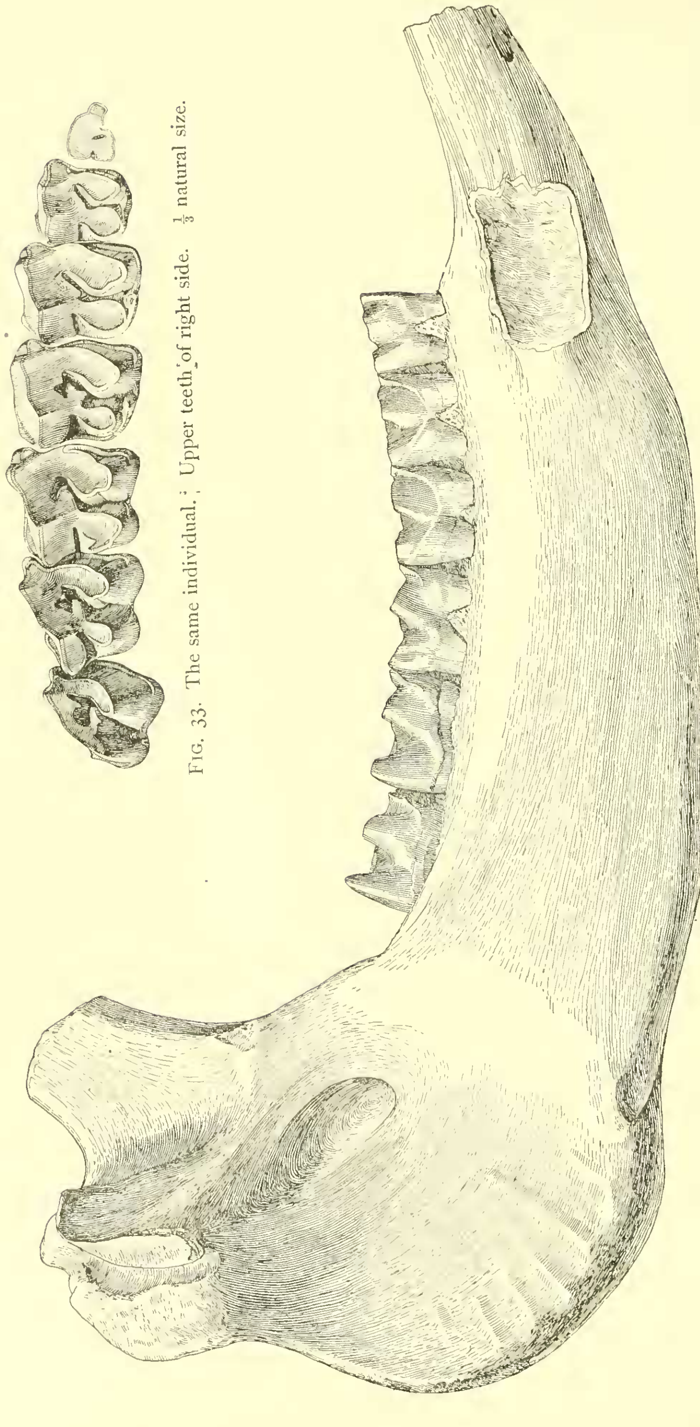

Fig. 33. The same individual. Upper teeth of right side. $\frac{1}{3}$ natural size.

Fig. 35. *Aphelops? ceratorhinus* (No. 857). Loup Fork. Left ramus of mandible. Inner view. $\frac{1}{3}$ natural size. Symphysial region not correctly shown in figure.

with cingula around posterior cross-crest. Small, inner, median, intermediate tubercles on P^2 and ^{3}. Mandible long and slender.

The teeth are much like those of *A. malocorhinus*, but the nasals are different. On the top near the extremities are convex rugosities indicating the presence of horns.

MEASUREMENTS.

	Mm.
Length of nasal processes	178
Length of upper molar premolar series	268
Length of lower molar premolar series	250
Length of mandible to anterior of $P_{\overline{2}}$	440
Depth of mandible under $M_{\overline{3}}$	108
Depth of mandible under $P_{\overline{3}}$	84

ARTIODACTYLA.

PALÆOMERYX? BOREALIS?

No. 806.

A portion of the middle upper portion of a skull with the bones broken off at the bases agrees in ever particular shown with *Palæomeryx? borealis* from the Flint Creek beds, and it undoubtedly belongs to the same genus if not the same species.

MERYCODUS? NECATUS? Leidy.

No. 857. Fig. 36.

Part of an antler from the Madison valley is much like the one figured in Leidy's Extinct Mammalian Fauna as *Cervus warreni*. It is longer and the burr is higher above the base.

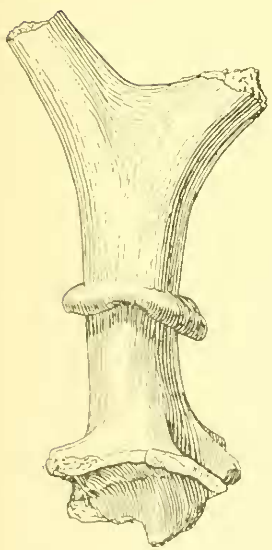

FIG. 36. *Merycodus? necatus?* (No. 857). Portion of antler. LoupFork. Lower Madison Valley. $\frac{3}{4}$ natural size.

MERYCODUS?

No. 804. Fig. 37.

This is quite different from the preceding. It is much larger and proportionally higher. The burr is very large and is nearer to the base of the antler. Above the burr the surface is much roughened.

PROBOSCIDEA.

MASTODON.

No. 785.

In the collection from Loup Fork beds of the Madison valley is the mandible of a young mastodon, which is of interest on account of its possessing the milk dentition. On one side the first premolar is present. It is a small tooth, only a fraction of the size of the succeeding one. It is elliptical in section, being longer than wide. The anterior portion is conical. Back of this and separated by a shallow transverse groove is a double heel or perhaps a rudimentary cross-crest, which by another slight groove is divided on top into two lateral tubercles, the outer one being the larger. $\text{dp}_{\overline{2}}$ is worn on the grinding surface. There were two principal cross-crests: the posterior ones are the larger, and the outer portion of the latter is much larger than the inner portion. Three small circular spots where the enamel is worn through indicate three tubercles on the anterior portion of the tooth. There was also a posterior median tubercle behind the posterior cross-crest, and on the outer side of this a smaller mammillary tubercle.

On $\text{P}_{\overline{3}}$ there are three principal cross-crests with at least two anterior and two posterior accessory ones. The principal cross-crests are high and unworn, and each is composed of two principal tubercles. The inner ones are the larger. Of the two posterior tubercles composing the heel the inner one is slightly the larger.

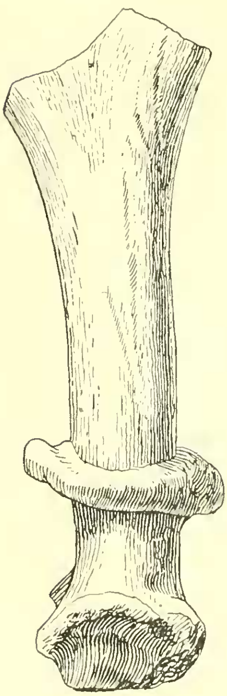

FIG. 37. *Merycodus?* (No. 804). Portion of antler. Lower Madison valley. ¾ natural size.

$\text{P}_{\overline{4}}$ was still buried in the base of the ascending ramus back of $\text{P}_{\overline{3}}$, showing the mode of succession to be just as in modern elephants. It was composed of three principal high cross-crests each with two cusps, as in $\text{P}_{\overline{3}}$ and the tooth was nearly of the same size.

The symphysis was quite long. The distance from the symphysis to P_1 is about the same as the length of P_3.

The mandible is that of an individual so young that I cannot at present assign it to any species.

EXPLANATION OF PLATE.

Contact showing unconformity between White River and Loup Fork beds, near Big Round Top about nine miles north of Logan, Lower Madison valley, Montana. The lower distinctly stratified beds are White River and at adjacent localities numerous fish remains were found. The upper less regularly stratified beds are Loup Fork and contain fossil plants and mammals.

CARNEGIE MUSEUM, February 25, 1903.